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SIZE AND DISTRIBUTIONAL RECORDS FOR TWO SPECIES OF *AGALYCHNIS* (AMPHIBIA: ANURA) IN MEXICO

Hobart M. Smith and David Chiszer

Abstract

Agalychnis moreleti is recorded at a maximum s-v length of 89 mm. *A. callidryas* at Venustiana Carranza and Mt. Ovando, Chiapas, is a first record for the Central Depression of the state.

On the occasion of a recent visit by Dr. John D. Lynch to the University of Colorado Museum (UCM), a number of previously unidentified amphibians from Mexico was examined, revealing two noteworthy series of *Agalychnis moreleti* (Duméril) and *A. callidryas* (Cope), here reported.

Agalychnis moreleti. Two large females (UCM 39766, 52484) were taken by Thomas MacDougall in the vicinity of Vista Hermosa, municipality of Comaltepec, district of Ixtlán, Oaxaca, Mexico, July-Oct., 1968, and Dec., 1970, respectively. The species has already been reported from the same locality (Duellman, 1970: 696), but both of the present specimens exceed the maximum s-v length he recorded (Duellman, 1970: 113) for the species, at 82.9 mm in females. The largest, UCM 39766, measures 89 mm s-v, the other 84 mm. Only *A. spurrelli* of *Agalychnis* is known to reach a greater s-v length, at 92.8 mm in females (Duellman, 1970: 124).

Agalychnis callidryas. Although several records for this species were reported by Duellman (1970: 965) very near the border of Chiapas, in the state of Tabasco, none were then available for the former state. Subsequently, Altig (1979: 61) reported the species from Pichucalco; Ramírez (1982: 167) from Laguna Bélgica, municipality of Ocozocuaautla; and Góngora (1987:29) from Lacanja-Chansayab, municipality of Ocosingo, all in the state of Chiapas. Johnson (1989: 4, 61) considered the species as an inhabitant of the Gulf Coastal Plain and Northern Highlands physiographic provinces. All of the records for Chiapas so far available fall within those provinces. None is available for the Central Depression Physiographic Province (Johnson, 1990).

It is therefore of considerable interest that two specimens (UCM 39601-2) of *A. callidryas* were taken by Eizi Matuda of La Esperanza, Chiapas (a coffee finca where he lived and studied botany for several decades), in the Central Depression and Sierra Madre physiographic provinces. One (39601) is from Venustiano Carranza, taken in May, 1941; this locality is at about the middle of the central Depression, on its northern edge. The other specimen (39602) was taken in June, 1940, on Mt. Ovando, about 10 km NE of Acapetahua in the Sierra Madre.

Both specimens are unfortunately totally discolored and extremely dehydrated. Faint vestiges of the lateral vertical lines characteristic of the species are evident in no. 39601, but are not visible in the other. Both have the typical digital webbing (Duellman, 1970: 91), scoop-shaped snout and prevomerine teeth (Duellman, 1970: 97) of the species. Each has numerous white spots scattered over the body, limbs and even on the tongue and floor of the mouth; they appear to be diseased tissues.

Occurrence of the species in the Central Depression of Chiapas is not particularly open to question, since relatively low altitudes occur there in the upper drainages of the Río Mescalapa system, specifically Río Chiapa. Occurrence on Mt. Ovando is definitely questionable, however. The species does not occur at high altitudes (up to 960 m fide Duellman, 1970: 112) nor on Pacific slopes north of Costa Rica (ibid.). It is possible that the "Mt. Ovando" specimen came from Atlantic slopes of the Sierra Madre somewhere on the south side of the Central Depression, northeast of Mt. Ovando, but it is very unlikely that it came from the Mountain itself, which is exclusively of Pacific drainage. We interpret both specimens as documenting the presences of *A. callidryas* only well within the Central Depression of Chiapas.

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We are much indebted to Dr. John D. Lynch for confirmation of the identity of the specimens here reported; to Dr. Shi Kuei-Wu for the privilege of studying the material; to Dr. William B. Lewis for facilities enabling our studies; and to Dr. Oscar Flores Villela for help with the literature.

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THE NOMENCLATURAL STATUS OF *LIMNOPHIS* GÜNTHER, 1865 (REPTILIA: SERPENTES)

Hobart M. Smith, George W. Byers, Kenneth L. Williams and
Van Wallach

Abstract

Limnophis Blanchard, 1845, is an "incorrect subsequent spelling" of *Limnobia* Meigen (1818). So interpreted, it has no nomenclatural status and does not invalidate the valid name *Limnophis* Günther, 1865.

As pointed out by Williams and Wallach (1989: 86), the currently accepted name *Limnophis* Günther (1865), for a genus of central African snakes (occurring in Angola, Zaire, Botswana, Zambia and Zimbabwe), is antedated by *Limnophis* Blanchard (1845) applied to a genus of crane flies, family Tipulidae, for which Meigen (1818) proposed the name *Limnobia*. From the latter genus Macquart (1834) separated a group that he named *Limnophila*.

However, it is clear from the original proposal that Blanchard's (1845: vol. 2, 455) *Limnophis* is a lapsus for *Limnobia*, because the name was attributed to Meigen, who never used that name but did propose *Limnobia*. That Blanchard meant that name is evident from his citation *Limnophila* (misspelled *Limnephila*!) Macquart as a synonym, inasmuch as Macquart (1834) erected that genus in partitioning Meigen's *Limnobia*.

Although it seems clear that Blanchard's *Limnophis* is a lapsus for the intended name *Limnobia* Meigen, his concept of that genus was that of Macquart's *Limnophila*, as indicated by his statement that usually 16 antennal segments occur, whereas what Meigen named *Limnobia* (now *Limonia* Meigen, 1803) typically has 14 antennal segments. That misidentification does not alter the fact that Blanchard obviously intended to write *Limnobia* instead of *Limnophis*.

The name *Limnophis* Blanchard has never been used as a valid name. Nomenclators (Sherborn, Schulze et al., Neave) uniformly regard the name as a substitute for ("emendation" of) *Limnophila* Macquart. Dipterists,

however, appear to have ignored the name or recognized it as a meaningless misspelling (e.g., Kertész, 1902). Were the emendation interpretation upheld, *Limnophis* Blanchard, 1845, would have to be accepted as a nomenclaturally available name, and *Limnophis* Günther would thus be a junior homonym that "must not be used as a valid name" (Art. 52a, 1985 Code), at least without resort to the plenary powers of the International Commission on Zoological Nomenclature.

On the contrary, we here hold it clearly evident, for the reasons previously stated, that Blanchard's name *Limnophis* was "an incorrect subsequent spelling" (Art. 33c) for *Limnobia* Meigen (not *Limnophila* Macquart), and that it "is not an available name and therefore does not enter into homonymy" (Art. 33c).

Accordingly, *Limnophis* Günther, 1865, is not antedated by any senior homonym that is available (*viz.*, *Limnophis* Blanchard, 1845), and no action is needed by the International Commission on Zoological Nomenclature to affirm the nomenclatural validity of *Limnophis* Günther, so far as known at present.

Also as noted by Williams and Wallach (1989: 86), the generic name *Limnophis* was proposed as new by Marsh (1871) for a fossil reptile. The same author, discovering that his name was preoccupied, later proposed the substitute name *Lestophis* (Marsh, 1885). Schmidt (1927), unaware of Marsh's substitute name, proposed *Paleoboa* as a replacement for *Limnophis* Marsh. The valid name *Lestophis* remains a *nomen dubium*, however, although it is referable to the Rhineuridae, a family of the reptilian order (or suborder) Amphisbaenia (Estes, 1983: 202), not to the Serpentes, as long thought.

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DISTRIBUTIONAL AND TAXONOMIC NOTES ON SOME LIZARDS OF THE GENUS *SCELOPORUS* FROM MEXICO

Hobart M. Smith

Material recently examined of the genus *Sceloporus* in the University of Kansas Museum of Natural History (KU), the James Ford Bell Museum of Natural History (JFBM) at the University of Minnesota in Minneapolis, and the University of Colorado Museum (UCM), has revealed several noteworthy range extensions and variations in four Mexican species and subspecies, here reported.

Sceloporus bicanthalis Smith

Although Smith (1937), in the original description of this taxon, recorded it from "Reyes", Oaxaca, and later (Smith, 1939) added the locality Mt. Zempoaltépetl in the same state, no records for that state were mapped by Guillette and Smith (1985) in their review of the *S. aeneus* complex, presumably because of uncertainty of identification. The species is likewise omitted from the herpetofaunal list for the state of Oaxaca in Flores and Gerez (1988: 214).

A series of eight specimens of this species (KU 137728-9, 137733-4, 137736-9) from Llano de las Flores (12 mi N Ixtlán de Juárez), 2720-2920 m, Oaxaca, confirms the presence of the species in that state and supports restitution of the other two localities of occurrence. "Reyes" = Pápalo Santos Reyes, or Santos Reyes Pápalo) is near the extreme northern end of the Sierra de Juárez (about 15 km ENE of Cuicatlán), and Llano de las Flores is near the southern end of that range, hence there is no question of accuracy of identification of the "Reyes". It is strange that the species does not occur in the well-collected Sierra de Aloapaneca, north of Cd. Oaxaca, just southwest of the Sierra de Juárez, although the latter is faunistically distinctive to a considerable degree. Mt. Zempoaltépetl, on the contrary, is separate from the Sierra de Juárez, but is part of the easternmost Sierra Madre Oriental, to which *S. bicanthalis* appears to be limited in Oaxaca.

All specimens have at least some evidence of dark bars on the throat, as is distinctive of this species; they are especially well developed in the single subadult male (38 mm s-v) which also has dark longitudinal streaks along the sides of the abdomen. The throat bars are clearly defined even in a near-hatchling male (28 mm s-v), but they are dim in all six females, even

the smallest (33 mm s-v). All have 2-2 canthals, and the postrostrals are 1-1 except for one with 1-2. The dorsals vary from 37 to 41 in all eight specimens; femoral pores 13-16 in six counts on four specimens; interfemoral pore scales 0-4 (0,2; 1,2; 4,1). In no respect does the series appear different from other examples of the species.

Sceloporus clarki boulengeri Stejneger

A single large male (JFBM 2914) from 9 mi S Zacualco, Jalisco, documents the second known locality of occurrence of the species in Jalisco, extending its known range southward about 140 km. The specimen is typical of the species, but has 11-11 femoral pores, like the other specimen from Jalisco (Hostotipaquillo; Smith, 1939: 132), but unlike most members of its subspecies, 97 per cent of which have 10 or fewer pores on each side, whereas 96 per cent of *S. c. clarki* Baird and Girard have 11 or more (Smith, loc. cit.). The possibility is suggested that the extreme southern populations of *S. clarki* may constitute a subspecies distinct from the others. More material is needed to resolve the question.

Sceloporus megalepidurus halli Dasmann and Smith

Of great interest is the second known specimen (KU 61698) of this subspecies, taken 7.5 mi E (probably SE, off of Hy 175) Tamazulapan, Oaxaca, about 35 airline km SW of the type locality, near San José Lachiguiri (Dasmann and Smith, 1974). Unfortunately it is a female, thus not confirming one of the subspecies' diagnostic character states, namely the absence of semeions in males. It is an adult, 49 mm s-v, with 43 dorsals, 14-15 femoral pores, five scales (minimum) between the femoral pore series, basal subcaudals smooth, four postrostrals, canthals 1-1, and supraoculars 4-4, large, in one series. The smooth basal subcaudals (Lynch and Smith, 1965) and small number of dorsals in this subspecies (43-46) differentiate *S. m. halli* from *S. m. megalepidurus* Smith (52-63), which is similar in lacking semeions in males. The single row of large supraoculars also distinguishes *S. m. halli* from both *S. m. megalepidurus* and *S. m. pictus*, although in the original description of the former no special importance was attached to the large supraoculars, presumably interpreted as a nontaxonomic variation. Occurrence of the same state in both specimens, however, as opposed to the regular occurrence of two rows in the other subspecies, suggests that it is taxonomically significant.

Sceloporus megalepidurus pictus Smith

A single specimen (KU 61697) from 2 mi W Yanhuitlán, 8300 ft, Oaxaca, extends the known range of the subspecies from southern Puebla into the northern part of the state of Oaxaca, a distance of about 140 km

(airline) southward from the Tehuacán region (Dasmann and Smith, 1974). Fortunately the specimen is an adult male, 48 mm s-v, with the typical, broadly dark-bordered abdominal semeions, thus differentiating it from both *S. m. megalepidurus* to the north, *S. m. halli* to the south. Its scutellation is typical, with 46 dorsals, 14-15 femoral pores, six scales (minimum) between femoral pore series, four postrostrals, canthals 1-1, and supraoculars in two rows (4-4 in inner row, 3-3 in outer row, latter scales two thirds size of former).

Neither of the two other species at present assigned to the *megalepidurus* group (*S. subpictus* Lynch and Smith, 1965; *S. cryptus* Smith and Lynch, 1967) can be involved in any intraspecific variation in *S. megalepidurus*, inasmuch as both have fewer than 38 dorsal scales, whereas 43 is the minimum recorded in any subspecies of *S. megalepidurus*.

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THE NOMENCLATURAL STATUS OF *CANTORIA* GIRARD, 1858 (REPTILIA: SERPENTES)

Hobart M. Smith, Reeve M. Bailey, Kenneth L. Williams and Van Wallach

Cantoria Girard, 1858, the currently accepted name for a genus of snakes of the Orient and Indo-Australian archipelago, has priority over the name *Cantoria* Kaup, 1858, for a genus of flatfishes whose currently accepted name is *Cynoglossus* Hamilton, 1822.

As pointed out by Williams and Wallach (1989: 26), the current and long-accepted name *Cantoria* Girard, 1858, for a genus of snakes occurring from southern Asia southward through the Indo-Australian Archipelago, was proposed in the same year as its homonym *Cantoria* Kaup, applied to a genus of marine fishes occurring in the eastern Atlantic Ocean of West Africa and in the Indo-West Pacific Ocean from eastern Africa to Japan and Australia. Relative priority of these homonyms is unsettled, although Whitley (1940) assumed that Kaup's name is the junior one and proposed *Cantorusia* as a replacement. Girard's name also has a junior subjective synonym (hence a potential alternative), *Hydrodipsas* Peters (1859).

The most critical fact in this case, relative to nomenclatural stability, is that *Cantoria* of Girard has long been accepted as the valid name for its genus, whereas *Cantoria* of Kaup has been regarded as a subjective junior synonym of *Cynoglossus* Hamilton (1822) in recent decades (e.g. Weber and deBeaufort, 1929: 186, 196; Menon, 1977: 16; Eschmeyer and Bailey, 1990: 74). Therefore no disruption of nomenclature occurs if Kaup's name is found to postdate Girard's.

Girard's name appeared at some time after Sept. 29, 1857, when his paper was accepted for publication at a meeting of the Academy of Natural Sciences of Philadelphia (p. 179). The paper was presented earlier, on August 11, 1857 (p. 175). Indeed, 1857 has commonly been accepted as the date of publication (e.g. Smith, 1943: 397; Gyi, 1970: 182), but evidence in Nolan (1913: xi), and the imprinted date for the 1857 volume as a whole (1858), led Williams and Wallach (1989: 26) to accept 1858 as the year of publication. General herpetological practice has been to accept Nolan's information, largely based on records of dates of receipt of the Academy publications by various eastern U.S. institutions. Unfortunately no records were found of receipt of some separately issued signatures, and obviously not all were promptly acknowledged. Therefore, as indicated by Nolan,

mailing dates (which are the nomenclatural dates of publication) were earlier than the dates given in his compilation, but at least never later. To complicate matters further, "The issue to authors of separate copies of papers from the Proceedings also antedates the publication of the numbers of which they form a part, the record being printed on the covers of the separata but not otherwise preserved." (Nolan, 1913: vii.) There is, however, no evidence of separate publication of this article.

Since Girard's description of *Cantoria* appeared in the issue containing only signature 13 of the 1857 volume, which ended with the very page (182) on which the description was printed, and was presented at the August 11 meeting of that year, it seems likely that distribution of that signature may well have occurred in 1857. Indeed, one of us (RMB), in collaboration with R. D. Suttikus, has carefully investigated the publication dates of other articles by Girard, on fishes, that appeared in the Academy Proceedings, and found that commonly an issue appeared within a month or two after the date of the last meeting covered by it, whereas acknowledgment of receipt might not be recorded for eight or more months after that date.

There were seven issues of the 1857 volume (vol. 9) (Nolan, 1913: xi). Receipt of the first issue, pp. 1-16, was acknowledged promptly, Feb. 25, 1857, but receipt was acknowledged for only two other issues in the volume: Jan. 7, 1858, for the third issue (pp. 73-100) and May 1, 1858, for the last issue (pp. 183-228). On the basis of that information, given by Nolan, recent workers (e.g. Williams, and Wallach, 1989) have tended to accept 1858 as the date of distribution (publication) of the sixth issue that includes Girard's article. That view is reinforced by the late receipt of the first issue of the 1858 volume April 19, 1858, by the American Antiquarian Society, which so promptly acknowledged (Feb. 25, 1857) the first issue of the 1857 volume.

Although subjective evidence suggests a strong likelihood that Girard's paper appeared in late 1857, the objective evidence indicates early 1858, which date we perforce here accept.

The first part of vol. 24 of the *Archiv für Naturgeschichte* contained Kaup's article in which he proposed *Cantoria*. We have found no evidence of publication date for that part, but part two was received at the Philadelphia Academy May 10, 1859, according to a list of "Donations to Library" in vol. II (p. x) of its Proceedings. That evidence, although indirect, strongly indicates that part one was not distributed earlier than late 1858, and may have been as late as early 1859.

We thus conclude that, beyond doubt, Girard's *Cantoria* 1858 has priority by at least several months over *Cantoria* Kaup, 1858.

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A SECOND LOCALITY FOR *GEOPHIS SALLEI* (REPTILIA: SERPENTES)

Hobart M. Smith and David Chiszar

Seven previously unreported specimens of *Geophis sallei*, including two hatchlings, are from a second known locality for this species: Santa Rosa, nr Lachao, Juquila district, Oaxaca, Mexico. None have a nuchal collar, hence *G. laticollaris* is resurrected as a valid species from the synonymy of *G. sallei*. The latter species was named for its collector, Auguste Sallé, whose patronymic species names should be spelled *sallei*, not *sallaei*.

Although Downs (1967: 171) was aware of eight specimens of *Geophis sallei* Boulenger when he monographed the genus *Geophis*, only one precise locality of occurrence was then known for the species: Cafetal Concordia, near Pluma Hidalgo, Oaxaca, Mexico. By virtue of synonymizing *G. laticollaris* (Smith et al., 1965) with *G. sallei*, an action that we here reject, Downs (1967: 168) added in a footnote the former species' type locality, 3 mi S Putla, Oaxaca.

A series of seven specimens in the University of Colorado Museum (UCM) adds a second locality of record for *G. sallei* (sensu stricto), and provides a basis for resurrection of *G. laticollaris*. At the same time we argue for emendation of the specific name from *sallaei*, as originally proposed by Boulenger (1894: 318), to *sallei*.

The specimens are UCM 52609-10, 52616-7 and 52527-9, all from Santa Rosa, near Lachao, district of Juquila, Oaxaca, taken in January, 1971 and July, 1972, by Thomas MacDougall. Lachao is located in the southern foothills of the Sierra Madre del Sur, as is Pluma Hidalgo, about 80 km SE Lachao. The range of the species is presumably more or less continuous between the two localities, since they are topographically similar as well as close geographically.

Unfortunately all except UCM 52527-9 are shrivelled and brittle; the exceptions are an adult female (52527), 304 mm s-v, tail 53 mm; an adult male (52528), 365 mm s-v, tail 51 mm; and a subadult male (52529) 182 mm s-v, tail 31 mm. The others cannot be sexed; two are of medium size, approximately 225 mm (52610) and 260 mm (52609) s-v; and two are essentially hatchlings, about 105 mm (52617) and 125 mm (52616) s-v.

Ventrals and caudals are reliably countable in all, however, the ventrals varying from 123 to 131, the caudals 29-38 (128 and 34-35 respectively, in the sexable female, 126 and 38, 125 and 32, in the two sexable males, respectively). The overlap between the two sexes in both characters is, according to Downs' data (1967: 170), too great to permit accurate determination of sex by use of those counts. All specimens are unicolor light to dark brown dorsally, whitish ventrally; the extreme ends of the ventrals are pigmented, and the pigment extends slightly mesad on the anterolateral edges of the ventrals. Cranial scutellation conforms with Downs' description, as does the coloration.

The most notable feature of pattern is the absence of a light nuchal collar in all specimens, even the juveniles. Downs apparently had no juveniles available to him, but conjectured that they might be collared; on that assumption he synonymized *G. laticollaris*, the only known specimen of which is a juvenile, 139 mm s-v, with *G. sallei*, because presence of a collar and larger eyes were the only differences supposedly distinguishing the former from the latter. UCM 52527-9, the only present specimens in which eye size is not distorted, has the eye diameter only very slightly less to very slightly more than its distance from the labial border, hence negates any difference in that character, unless it is stepped in geographic variation.

But because the holotype of *G. laticollaris* does have a conspicuous nuchal collar, whereas none of the 15 *G. sallei* now known does, even in hatchlings, we regard *G. laticollaris* as a distinct taxon. The only locality where it is known to occur, near Putla, is about 120 km from Lachao, considerably farther inland (about 90 km) than either locality known for *G. sallei* (20-25 km), on northern slopes of the Sierra Madre del Sur, and in a different drainage system. The two taxa could possibly be subspecifically related, but continuity of range seems unlikely.

The French collector Auguste Sallé obtained important although small herpetological collections in Mexico in the mid-19th century; his material ultimately went to the Paris and British museums (Kellogg, 1932). Three herpetological patronyms honor him: *Anolis sallaei* Günther, 1859 (= *Norops sericeus* Hallowell); *Hylodes sallaei* Günther 1868 (= *Eleutherodactylus rhodopsis* (Cope)); and *Geophis sallaei* Boulenger, 1894. Why Günther chose to render his eponyms as *sallaei* rather than *sallii* or *salleii* is not apparent; he was presumably attempting to approximate the -ii ending commonly in use at that time for eponyms. However, for another surname ending in -e, Cope, he wrote the name *copii* (as in *Aspidura copii* Günther, 1864, and *Leptognathus copii* Günther, 1872). Boulenger apparently was following precedent in adopting the spellings *sallaei* and *copii* for patronyms he created in subsequent years. Since all descriptions creating patronyms

for Sallé and Cope make it clear whom was honored, under Art. 32 (c)(ii)(example) of the Code, all patronyms for both workers should be corrected to *sallei* and *copei*, respectively.

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Environmental, Population and Organismic Biology, University of Colorado, Boulder, Colorado, 80309-0334 (HMS); and Department of Psychology, University of Colorado, Boulder, Colorado, 80309-0345 (DC).

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A MEXICAN GENUS OF TROPIDOPHEINE SNAKES

Hobart M. Smith and David Chiszar

A dwarf, boa-like tropidopheid snake is described, *Boella tenella*, as a new genus and species from the state of Oaxaca, Mexico, based on a single specimen without exact locality. The productive stem for family-group names based on generic names ending in *ophis* is *ophe*-.

The family Tropidopheidae is now a generally recognized group of primitive alethinophidian snakes (Dowling, 1986; McDowell, 1987; Rieppel, 1988), all extant members of which, in McDowell's (1987) classification, occur in tropical America. Two subfamilies are recognized in the latter work: the Ungaliopheinae, containing two living genera, *Exiliboa* of Oaxaca, Mexico, and *Ungaliophis* (Chiapas, Mexico to Ecuador), and the Tropidopheinae, also containing two extant genera, *Tropidophis* of the West Indies and northern Southern America, and *Trachyboa* of Panamá, Ecuador and Colombia.

An additional genus is here added to the Tropidopheinae, from Oaxaca. Its occurrence in that state along with *Exiliboa* suggests that separation of their two subfamilies was of great antiquity.

The additional genus is represented by a single specimen in a collection purchased from Thomas B. MacDougall (Smith, 1974) for the University of Colorado Museum (UCM). Unfortunately that particular specimen was one of the few lacking a locality label. However, data on the others provide a clue to its origin. The collection was made from August, 1969, to January, 1973, and numbers about 300 specimens (most under UCM 52376-52670). Localities represented are in eight provinces of the state of Oaxaca, as follows: Ixtlán (Comaltepec, La Esperanza, Llano de las Flores, Vista Hermosa), Juchitán (Palomares), Juquila (Santa Rosa, nr Lachao), Miahuatlán (San José, nr Lachigüiri), Mixes (Doce de Julio, Ixcuintepec, San Juan Evangelista), Oaxaca (Cerro San Felipe), Putla (San Vicente), and Tehuantepec (numerous localities). The largest series is from Santa Rosa, which lies in one of the least explored regions of Mexico, and it is from there that the snake most likely came. Several other especially notable species are represented in the Santa Rosa series, and all of the other collection sites are relatively well known.

Although of uncertain source, limitation of it at least to the state of Oaxaca, and probably to the southern Sierra Madre del Sur, suffice to justify making known this extraordinarily distinct genus and species, even though based on only one specimen.

Boella gen. nov.

Diagnosis. Small species (total length 580 mm in only known specimen) with a prehensile tail and body strongly compressed laterally; anal spurs present in females (therefore presumably in both sexes); dorsals smooth; scale rows 33-39-21; hyobranchial cornua parallel but separate, short (to 5th ventral); ventrals 264; caudals 65, entire; two loreals, one huge, half length of snout, eye to tip of rostral; internasals and prefrontals paired; nasals in contact behind rostral; kidney not lobulated; pupil vertical; posterior vertebrae keeled.

Content. One species, *B. tenella* sp.n.

Boella tenella sp.n

Holotype. UCM 56508, state of Oaxaca, Mexico, collected 1970-71 by Mr. Thomas B. MacDougall.

Diagnosis. As given for genus; preoculars 2-2; postoculars 4-4; 4-5 anterior temporals; 11-12 supralabials, 6-6/7 contacting eye; parietals subdivided, anterior pair of scales largest, contacting each other medially, supraocular laterally; nasal paired, nostril in suture between; a small, posteroventral loreal, about size of lower preocular; 6 scales bordering mental groove on each side; scent glands posterior to anal openings; scales of anterior and midbody scale rows largest near middorsum, gradually merging with the much narrower laterals (one-third size of dorsals) except for scales in one or two lowermost rows, which are about the same size as the middorsals; scales in all rows on posterior part of body of about same size, laterals slightly smaller.

Description of holotype. As given in diagnoses for genus and species, and as shown in accompanying figures; infralabials 12-13; penultimate ventral and first caudal divided; s-v, 491 mm; tail, 89 mm; total length, 580 mm.

Light tan above, with numerous, small, dark-brown-edged dorsal blotches, mostly 2-3 scales long and separated by 3-4 scales lengths, crossing most of dorsum; on neck the blotches are fused to form four dark lines that become paired blotches behind neck, these shortly fusing to form median blotches; an irregular series of numerous small dark brown spots,

separated by only one or two ventrals, extending onto lower dorsals. Head more or less uniform brown, somewhat darker than ground color of body; a narrow dark streak 1-2 scales wide from below and behind eye onto neck, continuous with the lower neck streak; supralabials and posterior infralabials lightly pigmented; rest of infralabials and mental dark; a distinct, short dark line on each side of gular region even with the median (6-11) infralabials.

The right ovary contains 10 enlarged follicles, readily distinguishable externally, and the left ovary 8; the largest follicles measure 4-4.5 mm in greatest diameter; only two or three are smaller. We conclude on these bases that the specimen is sexually mature, although it probably is not full grown. The species is thus one of the smallest of the "henophidian" taxa.

Comparisons. The five extant genera of tropidopheids, as now known, are remarkably distinct from each other (Bogert, 1968, 1968a). The non-lobulated kidneys and keeled posterior vertebrae of *Boella* associate it in the Tropidopheinae with *Tropidophis* and *Trachyboa* (McDowell, 1987), but the latter has heavily keeled scales on body, no or a vestigial rostral, nasals separated and single on each side, loreals indistinguishable, no more than 33 midbody scale rows or subcaudals, no more than 152 ventrals, a longer hyoid (to rib 9 or 10), no more than five paramental-groove scales, and no spurs in females.

Tropidophis has separated nasals, generally two pairs of prefrontals, no loreals, no more than 29 midbody scale rows or 225 ventrals or 45 subcaudals or five paramental-groove scales, a longer hyoid (at least to rib 7), no spurs in females, and a cylindrical or weakly compressed body.

In addition to the lobulated kidneys and flat ventral surfaces of the posterior vertebrae that characterize the Ungaliopheinae (McDowell, 1987) and differ from those features of *Boella*, both *Exiliboa* and *Ungaliophis* have at least the internasals (and in *Ungaliophis* also the prefrontals) unpaired, a single loreal on each side, nasals separated, and a cylindrical or weakly compressed body. *Ungaliophis* also differs from *Boella* in having the nostril pierced in the anterior of two nasals, no more than 10 supralabials or four paramental-groove scales or 25 midbody scale rows or 258 ventrals or 47 subcaudals, a longer hyoid (to rib 7) and no spurs in females.

Exiliboa differs from *Boella* also in having no more than seven supralabials, three paramental-groove scales, 21 midbody scale rows, 116 ventrals, or 24 subcaudals.

The large number of scale rows, ventrals, caudals and paramental-groove scales; two loreals; contact of nasals; and peculiar, greatly reduced

size of the dorsals on sides of body (except posteriorly) are all characters unique to *Boella*, among tropidopheid genera.

Etymology. *Boella* is a diminutive of *Boa* (Latin, snake) (Brown, 1954: 490), and *tenella* is a Latin adjective for "slender."

Remarks. The proper orthography under the Code of family-group names formed from generic names ending in *ophis*, the Latin transliteration of a Greek word for "snake," is subject to different opinions. Following the unexplained precedent established by McDowell (1987) and adopted in several other articles in the same volume, Smith and Preston (1987) argued that the uniquely correct stem of *ophis* for creating family-group names is *ophe-*. Contrariwise, Cannatella (1990) maintained that under the Code both stems (*ophi-* and *ophe-*) are correct, that the original family-name spellings (all using the *ophi-* stem), under article 32b (that correct original spellings are to be retained) are therefore to be maintained, and that to switch to use of the *ophe-* stem would, in addition to the preceding, be contrary to the spirit of the Code to maintain stability.

Appendix D VII, Table 2, of the Code gives examples as models for determining the stem to be used in formation of (a) derivative and compound words and (b) family-group names. The "grammatical" stem, formed in this case by dropping the final consonant of the nominative form, is, as explained in that table, to be used for the former, whereas the "productive" stem, derived by dropping the genitive singular case ending, is to be used for the latter. The word closest to *ophis* in orthographical form, given in the table, is *krisis*, whose grammatical stem is given as *kristi-*, its productive stem as *krise-*. Extrapolating from this example to *ophis*, the grammatical stem is *ophi-* (thus correctly yielding "ophidian" and *Ophisaurus*, for example) and the productive stem *ophe-*.

Article 29b explicitly defers to Appendix D VII for fixation of the standards for determination of the genitive singular stem used in formation of family-group names. Therefore *ophe-* is the correct stem in present contexts, and *ophi-* is incorrect.

Maintenance of the long-established usage in family-group names of the *ophi-* stem could be assured by appeal to the International Commission on Zoological Nomenclature. Stability is a most fundamental consideration of biological nomenclature (hence of the Code), and spelling of names as well as the names themselves fall within the purview of the Commission (Art. 77). Since no confusion whatsoever of name application is involved in the present situation, however, appeal for Commission intervention seems unjustified. For these reasons the spellings *Tropidopheoidea*, *Tropidopheidae* and *Tropidopheinae* are utilized here, and a general policy of use of *ophe-* as the

proper stem informatin of all other family-group names derived from generic names ending in *ophis* is regarded as uniquely correct.

Acknowledgments

Duane Baxter, Dr. Richard E. Jones and Kristen Lopez aided in study of the visceral anatomy of the holotype, Dr. Shi-Kuei Wu curated the material and permitted its study, Dr. William M. Lewis provided vital facilities, and Peter L. Cohee gave vital counsel in classical languages.



Fig. 1. Dorsal view, head of the holotype of *Boella tenella*.

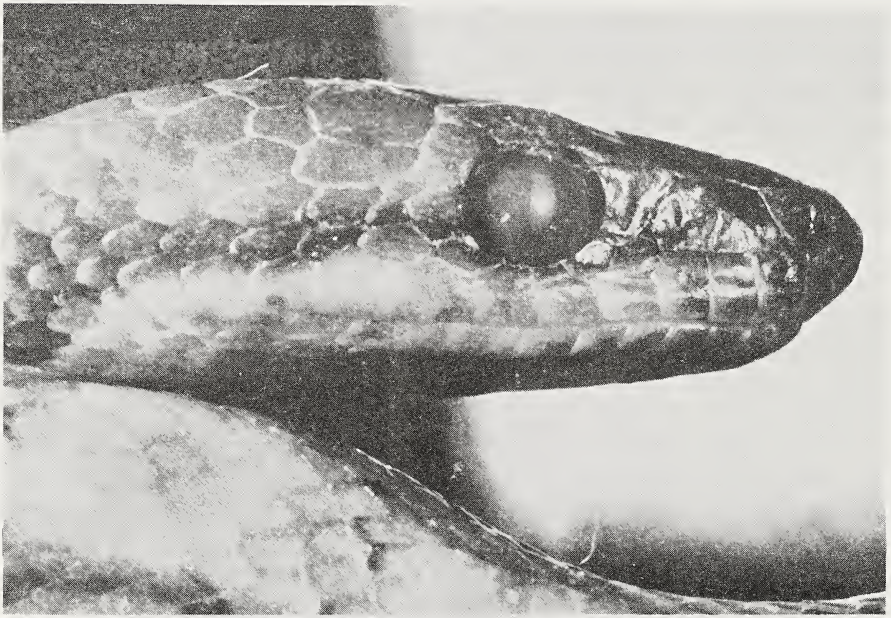


Fig. 2. Lateral view, head of the holotype of *Boella tenella*.



Fig. 3. Ventral view, head of the holotype of *Boella tenella*.



Fig. 4. Dorsolateral view of the holotype of *Boella tenella*.



Fig. 5. Ventrolateral view of the holotype of *Boella tenella*.

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NEWS & NOTES

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*NOTES:***Lecture and Field Trip Schedule**

Maryland Natural History Society
2643 North Charles Street, Baltimore, Md. (Phone 301-235-6116)

All lectures will be at the Society's Headquarters at 2643 North Charles Street, Baltimore, Md. For more information call the office at 301-235-6116 between 9:30am and 4pm on Wednesdays.

February 12 - Wednesday, 8:15pm - Monthly Lecture

"The Maryland Natural Heritage Program: Identifying and Managing Our Rare Species."
Janet McKegg - Maryland Department of Natural Resources

February 15 - Saturday, all day - Field Trip

Join us for a trip to the Calvert Marine Museum at Solomons. This remarkable new facility specializes in the maritime history of the Chesapeake. In addition to numerous cultural exhibits (an extensive collection of authentic bay boats, an entire lighthouse, historic photographs, etc.), they have a superb collection of Miocene fossils. We will have a chance to wander through the exhibit areas, visit the fossil lab and preview the fossil exhibits that are presently under construction. We will carpool from the metro area and meet at the museum. Bring your own lunch or plan to visit one of the nearby restaurants. Museum entry fee of \$3.00. Contact Butch Norden for information at 410-974-3589 or leave a message at 235-6116.

March 5 - Thursday, 8:15pm - Special Lecture

"A Naturalist's Ramblings through the Baja Peninsula."

David S. Lee - North Carolina State Museum of Natural Science. Mr. Lee, a former Baltimore resident and long time member of the Maryland Natural History Society, is well known in the field of herpetology.

March 25 - Wednesday, 8:15pm - Monthly Lecture

"Experiences With Natural History Museums from California to Delaware."

Glen Ives - Director, Delaware Museum of Natural History

NOTEThis exciting lecture coincides with our 63rd annual meeting and yearly social. Nonmembers and members alike are invited to join us for wine and cheese as we celebrate the long history of the Maryland Natural History Society.

April 11 - Saturday, All Day - Field Trip

We are off to Devonian and Pennsylvanian fossil localities in western Maryland. This one day trip will take us to several interesting sites that usually yield a wide variety of invertebrate and plant fossils 270 to 400 million years in age. We will carpool from the metro area and meet at the Park and Dine Restaurant in Hancock for breakfast. Contact Butch Norden for additional details at 410-974-3589 or leave a message at the Society headquarters. Bring your lunch and rock hammer.

April 15 - Wednesday, 8:15pm - Monthly Lecture

"The Role of the U.S. Fish and Wildlife Service in the Conservation of Rare and Endangered Insects."

Judy Jacobs - U.S. Fish and Wildlife Service

May 16 - Saturday, All Day - Field Trip

Meet at the Smithsonian in Washington to see and discuss Maryland dinosaur fossils. After lunch we will visit some nearby sites where fossils have been collected. Size of group will be limited so contact Butch Norden to make arrangements, 974-3589. We will meet in front of the Natural History Museum at 10am (parking along mall is prohibited before ten, but if you arrive between 9:30 and 9:45 you can park and sit in your car). Lunch can be purchased at the Museum (ok, but overpriced) or bring your own and we can eat on the mall by the Triceratops.

-continued-

NEWS & NOTES

May 13 - Wednesday, 8:15pm - Monthly Lecture

"Recent Changes in the Definition of Species Based upon Research on Hybrid Ferns." - Donnell Redman

SPRING NATURE WALKS AT CYLBURN

THURSDAYS - 9:00 AM Meet at Cylburn Mansion House, 4915 Greenspring Avenue

NOTE: The walks are canceled if it is raining. Special help for beginning birders.

- April 2 Winter & Residential Birds, Wildflowers.
Leaders: Jean Worthley and Christine Bowen.
- April 9 Wildflowers, Early Nesting Birds & Possible Migrating Birds.
Leaders: Jean Worthley and Christine Bowen
- April 16 Wildflowers & Migrating Birds.
Leaders: Jean Worthley and Christine Bowen.
- April 23 Migrating Birds and Wildflowers.
Leaders: Jean Worthley, Christine Bowen and Erana Lubbert.

SPRING - ALL COUNTY WALKS

Meet at the rear of Howard Johnson Restaurant, Dulaney Valley Road & Fairmont Avenue, Towson. We will leave promptly at 8:00 AM. BRING LUNCH. For additional information on meeting place - phone Erana Lubbert 301-339-6133. NOTE: All walks canceled if it is raining.

- April 30 Susquehanna State Park - Harford County (All Day)
For Gleason's Trillium by the thousands, other spring flowers and migrating birds.
Leaders: Rodney Jones and Erana Lubbert
- May 7 Monkton - Dr. Dandy's Fissure Estate (All Day)
Bobolinks & Yellow Orchids and much, much more.
Leaders: William Gray and Erana Lubbert
- May 14 Woodstock (All Day)
To Patapsco River for Cerulean Yellow Throated plus other resident & migrating birds.
Wildflowers also.
Leaders: William Gray and Erana Lubbert
- May 21 Gunpowder State Park
Long but easy walking trail. Migrating birds & spring wildflowers.
Leaders: William Gray and Erana Lubbert

LEADERS

Christine Bowen	301-859-8200	Erana Lubbert	301-339-6133
William Gray	301-730-5655	Jean Worthley	301-374-5370
Rodney Jones	301-486-3442		

NOTES:

Prepublication Announcement

A Revised Checklist with Distribution
Maps of the Turtles of the World

by John B. Iverson

Publication date: April 1992

This is a substantial **revision** of Iverson's 1986 Turtle Checklist. At approximately **370 pages**, it is 33% longer than the earlier version, and is now the most comprehensive guide available to the scientific nomenclature of the turtles of the world. The Checklist includes updated distribution **dot maps** (nearly 270 total) for all species, and information on the **original citations, type specimens, type localities, distribution, and pertinent literature** for all recognized **species AND subspecies**. Dichotomous **keys** modified from the scientific literature are also included for identification down to the species level. **Phylogenetic relationships** are also illustrated for most taxa. This edition is currently available only in soft cover. Cost is **\$25.00 prepaid** (including surface shipping; foreign airmail shipping is \$10.00 extra). All payments must be in U.S. dollars, drawn on U.S. banks, or on an international money order.

CARETOCHELYIDAE
Family Caretochelyidae (Iverson, 1987)
Phylogenetic status

Distribution: All for the species listed.
Comments: These species related to the Testudinidae, according to Gauthier (1974), Four (1983), and
Nelson (1987). Comments and references to other species in the 1986 list.

Carettochelys (Iverson, 1986) 14
Phylogenetic status

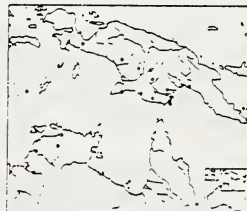
Type species: *Carettochelys insculpta* (Boulenger, 1886) (in Nelson, 1987)
Comments: This is the new genus name.

Carettochelys (Iverson, 1986) 14
Phylogenetic status

Comments: *Carettochelys insculpta* (Boulenger, 1886) (in Nelson, 1987)
Comments: This is the new genus name.

Distribution: All for the species listed.
Comments: These species related to the Testudinidae, according to Gauthier (1974), Four (1983), and
Nelson (1987). Comments and references to other species in the 1986 list.

Comments: *Carettochelys insculpta* (Boulenger, 1886) (in Nelson, 1987)
Comments: This is the new genus name.



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NEWS & NOTES

February 9, 1992

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- PROJECT:** THE DISTRIBUTION AND ABUNDANCE OF HERPETOFAUNA AMONG HABITAT TYPES AT REMINGTON FARMS, CHESTERTOWN, MARYLAND.
- RESPONSIBILITIES:** The successful applicant will assist a graduate student in conducting a community level study of amphibians and reptiles inhabiting different habitat types on Remington Farms. Duties will include constructing and installing drift fences and live traps; collecting, measuring, weighing, marking, and releasing amphibians and reptiles; and measuring and recording various habitat parameters.
- QUALIFICATIONS:** Experience in wildlife ecology, zoology, biology, or herpetology would be helpful, though not necessary for this position. A keen interest in amphibians and reptiles is desirable.
- STARTING AND ENDING DATE:** The assistant will be required from mid-February through May, 1992. A part-time schedule may be possible for a longer period of time if so desired.
- SALARY:** \$5.00/hr plus housing on the farms if needed.

Interested applicants should contact Rod McLeod or Mark Conner at:

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NOTES:



Second World Congress of Herpetology

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Society Publication

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DEPARTMENT OF HERPETOLOGY

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NOMENCLATURAL FIXATION OF *SCELOPORUS FORMOSUS* (REPTILIA: SAURIA) AND THE STATUS OF *S. SALVINI*

Hobart M. Smith and Gonzalo Pérez-Higareda

A lectotype is designated for *Sceloporus formosus*, and its type locality restricted to the vicinity of Xalapa, Veracruz. One lectoparatype represents *S. salvini*, and presumably also is from the vicinity of Xalapa. The latter species occurs in mountains southeastward to southwestern Guatemala, and in the isolated Los Tuxtlas Mountains, as well as southwestward from the Isthmus of Tehuantepec at least to the Pluma Hidalgo area. *S. internasalis* is a junior synonym. The species is unique in having highly fragmented internasal scales and the frontonasals separated from each other. No subspecies are recognized.

As recorded by Taylor (1969: v), Wiegmann's (1834: 50, pl. 7 fig. 2) *Sceloporus formosus* is documented nomenclaturally by not only the original description but also by the specimens under six numbers, 632-637, in the Zoologisches Museum in Berlin. Taylor stated that those numbers pertained to six specimens, but actually no. 633 was applied to two specimens; the others were applied to one each.

Inasmuch as the proper allocation of the name *Sceloporus formosus* is in some doubt, due to the multiplicity of the taxa in its group, Dr. Günther Peters, then (1978) curator of herpetology in the Berlin Museum, kindly loaned to HMS the entire series of seven syntypes of that species. The press of other duties has prevented study of that material until the present time. In the interim, several office and laboratory moves and the departure of an intended collaborator conspired to misplacement of the two specimens under no. 633; they cannot now be found. Dr. Rainer Günther has nevertheless kindly extended the loan to permit completion of the study; all five remaining specimens have now been returned to the Berlin Museum.

Of the five specimens, four (634-7) are clearly representative of the species to which the name has been applied, as in Smith (1939). The fifth, no. 632, represents the species now known as *S. salvini*.

The localities from which these syntypes came are unknown. However, Stresemann (1954) outlined the travels in Mexico of Ferdinand Deppe, who undoubtedly was solely responsible for collecting the material, although Count von Sack, a wealthy nobleman, is recorded in the Berlin

Museum catalog as a co-collector of the syntypes. Actually Deppe seems not to have travelled with the Count in Mexico at all; they debarked at Alvarado, Veracruz, in December, 1824, and Deppe remained in the count's employ until May, 1825. The dual attributions of collectors for these syntypes suggests that they may all have been collected in early 1825, when they were at least nominally together. Certainly during that time Deppe is known to have travelled rather extensively in central Veracruz, whence it is presumed that the specimens came. He is known to have gone to Mexico City in early 1825 via Xalapa, not by the Orizaba route, which he would have taken had he gone through Acultzingo, to which the type locality was restricted by Smith and Taylor (1950: 346). There is no record that he ever took the Acultzingo-Orizaba route to Veracruz, hence we here revise the type locality for *Sceloporus formosus* to Xalapa, Veracruz, where it is certain that Deppe visited and that *S. formosus* occurs. Variation among the four syntypes of that species includes what is known for that area; at least three of them seem typical for that region.

It is highly likely that the syntype representing *S. salvini* also came from the Xalapa area; the species is already known from there, and indeed hitherto only there in the state of Veracruz.

Sceloporus salvini Günther

The single syntype referred to this species (ZMB 632) is an adult female 88 mm s-v, tail regenerated. Nasals separated from rostral by one scale, narrowly contacting lorilabials on one side, narrowly separated on the other. Internasals fragmented, four in a transverse row between nasals, posterior to the four postrostrals, and six in the following row, followed by three scales between the anteromedial edges of the lateral frontonasals; a scale separating the latter on each side from the small median frontonasal; rear apex of latter split off as a very small, separate scale; prefrontals very narrowly in contact medially; frontal ridges prominent; supraoculars in two rows, but the lateral scales (3-4) $1/3$ to $1/4$ size of the adjacent four largest medial scales (4-5); frontal divided, narrowly contacting interparietal, separating the two frontoparietals; latter contacting one rear supraocular on one side for about $1/2$ the latter's medial border. Two canthals, the anterior situated above the canthal ridge one side; head scales essentially smooth, but most with sensory pits, usually along their free posterior edge.

Dorsals 37 interparietal to base of tail; femoral pores 12-12, the two series separated by 13 scales. Specimen discolored, slightly distorted, slightly soft in abdomen; outer scales shed on anterior third of trunk, where the underlying scales appear blue-black; a narrow black collar appears to be present in front of the forelegs involving two or three scale rows near

midline, complete dorsally (a possible midline interruption may exist) and on sides, but not evident ventrally; on middle and rear part of dorsum of trunk, the scales have not been shed, and reveal irregular, narrow (mostly one scale width), broken crossbands or transverse series of spots extending onto sides and continued on tail as a paired series of spots.

This syntype is identified as *S. salvini* rather than *S. formosus* because of the numerous internasals, separation of the median from the lateral frontonasals, and the relatively few femoral pores. In *S. formosus* the femoral pores are never fewer than 13, the internasals never so reduced in size, and the median frontonasal always contacts the lateral frontonasals.

Much more critical is a comparison with *S. internasalis* Smith and Bumzahem (1955). Stuart (1971) vastly expanded the concept of range of that species, to include southern Veracruz (vicinity of San Andrés Tuxtla) and montane southwestern Guatemala, focussing primarily upon the extensive fragmentation of the scales in the internasal and median frontonasal areas, accompanied by a relatively small number of femoral pores (21-27 total), compared with *S. formosus*, and moderate-sized dorsals (35-40). However, those features occur also in *S. salvini*, as noted by Smith (1939: 55-56). Stuart (1971) dismissed that species from consideration in the complex with fragmented internasals because it is described as having "two well-developed rows of supraoculars", but that feature is subject to considerable variation at least west of the Isthmus of Tehuantepec. Since no appraisal of the fragmented-internasal species, referred to as *S. internasalis* by Stuart (1971), as it occurs in Mexico, has appeared since Stuart's revision, a survey was made of all readily available material from west of the Isthmus of Tehuantepec. It has become apparent that the names *S. salvini* and *S. internasalis* are based on the same species, and although considerable geographic variation exists, it does not appear consistent enough to warrant recognition of subspecies at the present time.

In Mexico, the species is very readily and infallibly distinguished from all members of the *formosus* group by separation of the medial and lateral frontonasals from each other. One, two or all of those scales are commonly reduced in size, in conjunction with fragmentation of the internasal scales which in extreme cases are reduced to rounded granules, but in others remain angular although irregular and of moderate size. *S. formosus*, *S. stejnegeri* and *S. tanneri*, all members of the *formosus* group occurring in Oaxaca and Guerrero (*S. stejnegeri* very likely extends into western Oaxaca, although not yet recorded there), all have the three frontonasals large and in contact with no or very rare exception, and the internasals are not particularly fragmented. Stuart (1971) has confirmed the nearly perfect constancy of the frontonasal character in the species in the

Guatemala, Chiapas, Veracruz and Oaxaca material he examined (two exceptions in 39 specimens from Chiapas, two in 40 from Guatemala, none in ten from Oaxaca and Veracruz).

Material we have examined extends the known range of *S. salvini* somewhat, and fleshes out the range in other parts, as follows. VERACRUZ: Xalapa (MCZ 46935, 136000-5); presumably Xalapa area (ZMB 632); 20 km ENE Jesús Carranza, 200 ft (KU 27511-2); 25 km SE Jesús Carranza (KU 27513); Estación de Biología Tropical Los Tuxtlas, 150 m (UCM field 160); Balzapote, Los Tuxtlas area (UCM 51890); 2.5 mi N La Palma, Los Tuxtlas area (UTA 3097); Arroyo Claro, Sierra de Santa Marta, Los Tuxtlas area, 1000 m (UCM field 323-7). OAXACA: West of Figueroa, 5000 ft (a few km NE Pochutla) (UCM 39835-8); Metates, N slope Sierra Juárez, 17.7 km S Valle Nacional (UTA 11785, 24008, 11783-4); San Pedro Yetla, 7 km S Valle Nacional (KU 87372); 2 mi E Tolloquito (KU 40146); 2 mi S Tolloquito (KU 40147); Vista Hermosa (UCM 39839, 49443). CHIAPAS: Linda Vista, 2 km NW Pueblo Nuevo Solistahuacán, 1675 m (KU 59694); Cerro Ovando (UCM 39661).

The species has a considerable vertical range, from 61 m (20 km ENE Jesús Carranza, Veracruz) to 2500 m (Cerro Paxtal, Chiapas). Its geographic range extends from central Veracruz through northern Oaxaca and across the Isthmus of Tehuantepec onto the uplands of Chiapas to extreme western Guatemala, and along the Sierra Madre del Sur of Oaxaca at least as far southwest as Pochutla.

Distribution over much of this range appears to be rather spotty, with local variational tendencies whose extremes are usually matched in an irregular pattern elsewhere. The fewest femoral pores (10) occurs most frequently in the Balzapote and Sierra de Juárez series, but the highest number (15) occurs in the Sierra de Santa Marta series, very near Balzapote, and in the Figueroa series. The Jalapa series has the highest mean dorsal scale count (40.5), with a range in 8 specimens of 37-44. A high of 40 occurs in the Figueroa and Arroyo Claro series, and all other counts are lower, 35-39. The total range of dorsals, 35-44, is not exceptional. The supraoculars are highly variable, from one row of large scales in some specimens of widely scattered occurrence, especially common in the Los Tuxtlas area, to two rows, the outer of which consists of 1-4 very small to large (one half to two thirds size of inner supraoculars) scales; the Jalapa series has the largest outer supraoculars, but they vary from small to large and are matched in every other sizeable series.

The black collar is most prominent, broadest (2-5 scales) and most frequently complete, or nearly so, in the Jalapa series, but it is closely matched in the Sierra de Juárez series, and to varying degrees in others; a

width of three rows is common everywhere, and drops to two frequently. The middorsal interruption varies from one to several scales in various parts of the range. In general the collar width appears to diminish toward Guatemala, and the size of the medial interruption appears similarly to increase.

These erratic variations appear to preclude recognition of any geographic races. All have two canthals and separation of the nasal from the lorilabials, with one exception each. The supraoculars contact the parietal in none, conforming in these respects with Stuart's (1971) characterization of *S. internasalis* (= *S. salvini*). The largest specimen examined was a female 100 mm s-v (UCM field no. 326), and the largest male measured 94 mm s-v (UCM field no. 323).

The variation occurring in the representative samples examined of *S. salvini* leaves no question of assignment of ZMB 632 to that species.

Inasmuch as a lectotype is designated in the following pages for *S. formosus*, ZMB 632 becomes a lectoparatype and is no longer to be considered a syntype fide the 1985 Code.

Sceloporus formosus Wiegmann

Lectotype. ZMB 635, an adult male, the largest of the syntype series of this species. Paralectotypes. ZMB 634, 636 and 637, of those presently at hand; no. 637 is a female, the other two males, and all are adults. The two specimens at present misplaced, under the number ZMB 633, are likewise lectoparatypes. None is to be considered a syntype in the future.

Description of the Lectotype (see Figs. 1-3). Specimen somewhat soft abdominally, but not discolored; s-v length 83 mm, tail 105 mm; dorsals 36; femoral pores 17-18; scales between pore series 6. Uniform bluegreen above and on sides, except for a black collar in front of arms, complete ventrally but widely broken dorsally by 8-9 scales. Other characters as depicted in Figs. 1-3.

The main reasons for selecting this specimen as lectotype are not only that it is the largest of the series, is the least distorted and exemplifies very well the distinctive characteristics of the species with which the name has always been associated, but it appears to be the very one illustrated in the original description (Wiegmann, 1834; pl. 7, fig. 2, correctly identified in the text, p. 50, but erroneously stated in the legend on the plate as representing *S. torquatus*). The dark borders of the abdominal semeion, and the black ventral collar on the neck, are shown in the figure exactly as in the lectotype, and the hind legs are positioned exactly the same way. The only notable difference is that in the lectotype it is the right arm that is extended

forward, the left directed posteriorly, rather than the reverse as shown in the figure; presumably an artistic license to switch the limbs was exercised for esthetic reasons.

A cause for some concern in selecting ZMB 635 as lectotype is the relatively small size of the supraoculars of the inner row, and the relatively large size of those in the outer row. Normally the scales of the inner row are 3-4 times the size of those in the outer row, and in some specimens there is but one row. The variation in size of the supraoculars may well be geographically correlated, although not wholly so. Primarily because all of the Deppe specimens of this species collected while associated with Count von Sack presumably came from the Xalapa area (to which we have here restricted the type locality), as indicated by the itinerary deciphered by Stresemann (1954), we conclude that the small supraoculars of the lectotype represent merely a variant of the Xalapa population. The three lectoparatypes of this species have typically large supraoculars in the inner row.

Lectoparatypes. The three lectoparatypes referred to *S. formosus*, ZMB 634, 636 and 637, have the following characters, respectively; male, male, female; dorsals 34, 32, 36; largest lateral supraocular 1/4 - 1/5, 1-6, 1/6 size of largest medial supraocular; 3-3 lateral supraoculars in all; internasals 2-2, 2-1, 2-2; femoral pores 16-16, 15-16, 14-15; scales between pore series 7, 7, 4; s-v length 77 mm, 60 mm, 73 mm. The males are blue-green above, not discolored, have a dark slash in front of arm insertions continuous across throat in 634, narrowly interrupted midventrally in 636, ends tapering to a point dorsally on each side, widely (5, 7 scale widths, respectively) separated. The abdominal semeions are prominent, reaching from axilla to groin, with a black medial border about three scales wide at midbody, much wider in axilla and groin, separated at midbody by 3-4 scale rows, not encroaching onto chest or sacral regions. Throat bluish, lighter anteriorly in 636.

The single female appears dorsally much like the males, due to loss of most outer layers of the scales; ventral surfaces unmarked; black patch in front of arm insertions small, not extending onto ventral surface.

Acknowledgments

We are greatly indebted to Drs. Günther Peters and Rainer Günther for the privilege of studying the former syntypes of *S. formosus*; HMS abjectly apologizes for the hopefully temporary loss of two of those specimens. We are also grateful to Dr. William M. Lewis, Jr., for provision of facilities for study; and to Dr. Wm. E. Duellman, John E. Simmons, Dr. Jonathan A. Campbell, José P. Rosado and Dr. Shi Kuei Wu for the privilege of studying material in their museums.

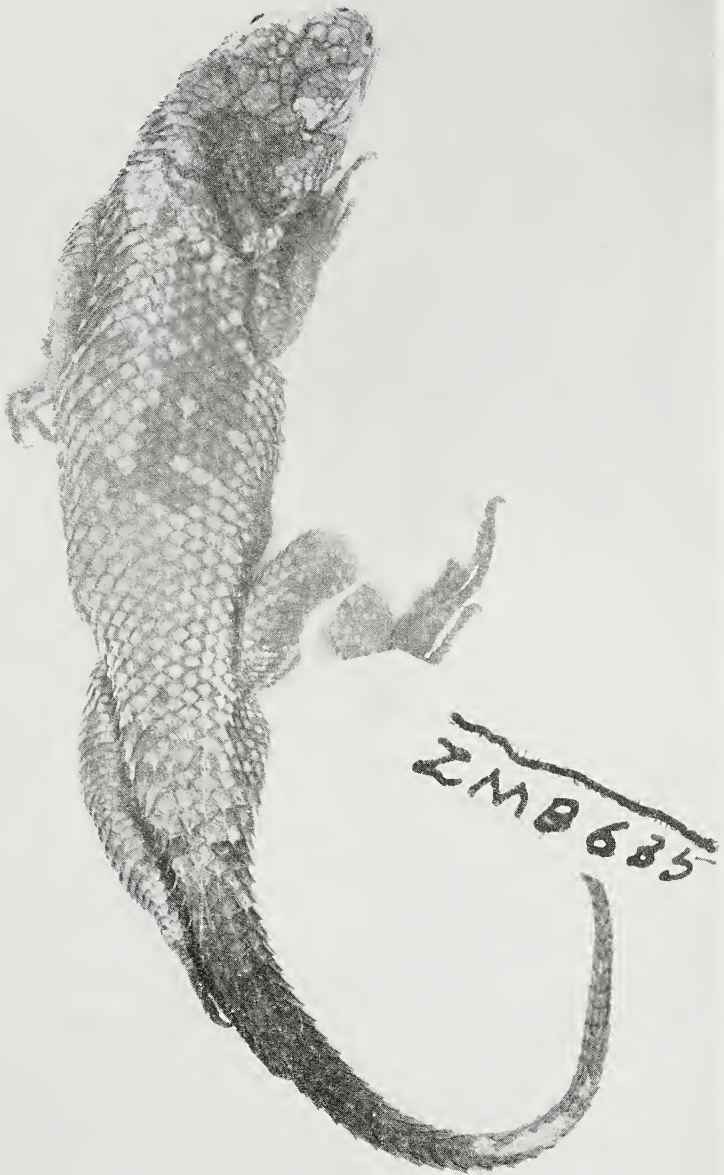


Fig. 1. Dorsal view of lectotype, ZMB 635, of *Sceloporus formosus*, 83 mm s-v.



Fig. 2. Ventral view, same specimen as in Fig. 1.

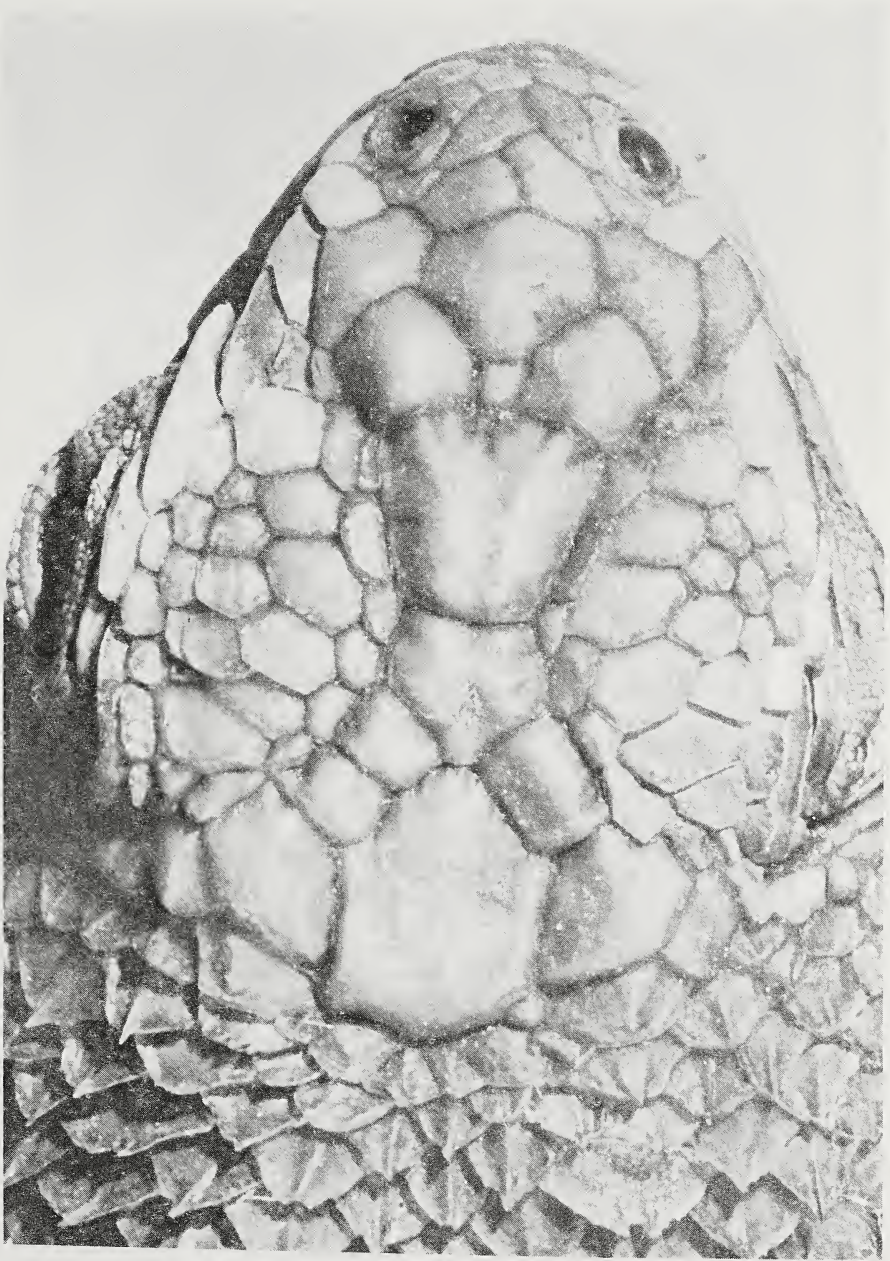


Fig. 3. Dorsal head scales, same specimen as in Fig. 1.



Fig. 4. Dorsal head scales of a paralectotype (ZMB 637) of *Sceloporus formosus*, showing the typically large supraoculars of the species.



Fig. 5. Dorsal head scales of the paralectotype (ZMB 632) of *Sceloporus formosus* that actually represents *Sceloporus salvini*.



Fig. 6. Dorsal head scales of *Sceloporus salvini*, field no. 160, from the Los Tuxtlas area, southern Veracruz, showing the highly fragmented internasals characteristic of the species, and notably more fragmented than in ZMB 632 (Fig. 5).

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SCELOPORUS HORRIDUS AND *S. SPINOSUS* (REPTILIA: SAURIA) ARE SEPARATE SPECIES

Hobart M. Smith and David Chiszar

Sceloporus horridus (with its three subspecies, *S. h. horridus*, *S. h. oligoporus* and *S. h. albiventris*) and *S. spinosus* (with its three subspecies, *S. s. spinosus*, *S. s. caeruleopunctatus*, and *S. s. apicalis*) are separate species, occurring sympatrically from south-western and southern Puebla to north-central Oaxaca. Intergradation is documented between *S. s. apicalis* and both *S. s. spinosus* and *S. s. caeruleopunctatus*, but seemingly does not occur between the latter two subspecies, contrary to the previous concept.

Critical material examined from southern Puebla and Oaxaca in the collections of eight museums (AMNH, CAS, FMNH, KU, UCM, UIMNH, UMMZ, UTA; see Leviton et al., 1980) has made it evident that, contrary to the proposition by Boyer et al. (1983), *Sceloporus horridus* Wiegmann and *S. spinosus* Wiegmann are allospecific, not conspecific, and that *S. s. apicalis* Smith and Smith, not *S. s. caeruleopunctatus* Smith, intergrades with *S. s. spinosus*.

A. Allospecificity of *S. horridus* and *S. spinosus*

Proposal by Boyer et al. (1983) that *S. horridus* and *S. spinosus* are conspecific was predicated on intermediacy between the usual character-states of the two oculofrontoparietal series of scales in the two species as seen in a series of nine specimens from near Tlaxiaco, Oaxaca, a locality between the known ranges of the two species. No localities of sympatry were then known between the extensively parapatric ranges of the species. However, material now available documents sympatry in at least two localities, and an overlap of their ranges of about 150 km from southern Puebla to central northern Oaxaca (Fig. 1). Localities and areas of note are as follows.

1. San Diego, Puebla. This locality, about 2 km SE Tehuacán, is represented by six specimens of *S. spinosus* (UMMZ 195757 (1 spec.) and 88617 (5)) and 15 of *S. horridus* (UMMZ 88615 (10 spec.) and 88616 (3), and UIMNH 48943, 48945). The six *S. spinosus* have 7-10 (\bar{x} 8.7) femoral pores, the 15 *S. horridus* 3-5 (\bar{x} 4.2) on each thigh, and this is the most reliable difference between the two species. One supraocular is in contact with the

median head scales on both sides of one *S. spinosus*, but in all *S. horridus* except on one side of two. The close approximation of other locality records throughout much of the surrounding area, for both species, suggest widespread sympatry in that region.

2. 0.5 and 2 mi S. Guelatao, Oaxaca. This is the southeasternmost known locality of occurrence of *S. horridus*, about 56 km NE Cd. Oaxaca. Five adult specimens (UIMNH 60452-3, UCM 38313-5) appear typical, with 29-30 dorsals, 3-5 femoral pores and 4-4 supraoculars of which one is in contact with the median head scales. One *S. spinosus* (UCM 38364), a subadult male, has 30 dorsals, 7-7 femoral pores, and 4-4 supraoculars; the rear supraocular is in contact with the median head scales on each side. The latter condition is typical of *S. horridus*, but does occur in a small percentage of *S. spinosus*. Never do seven femoral pores occur in *S. horridus*, however, so far as is now known, hence no. 38364 is unquestionably referable to *S. spinosus*.

3. Other *S. horridus* from Oaxaca. A typical specimen (CAS 87311) from 2 mi SW Ixtlán de Juárez, 5400 ft (28 dorsals, 5-5 femoral pores, 4-4 supraoculars, rear one contacting median head scales), confirms the occurrence noted previously near Guelatao; the collecting sites may well be exactly the same.

On the road southeast from Tehuacán, a locality 2 mi S Teotitlán, just across the Oaxaca border, is represented by two specimens (UCM 38336-7), and, some 30 km farther southeast, a locality 2 mi S Tecomavaca is represented by one (UCM 38335). To the southwest from Tehuacán, the species has been taken 59 km SW Acatepec, Puebla (near Cuyotepeji) (UTA 6386), at El Espinal, 11.6 km S jct Hys 126 and 190, on 190 (UTA 25799), and 2 mi NW Tamazulapan (UTA 33807, 48997). These seven specimens conform with previously established limits of the species, having 29-32 dorsals ($\bar{x} = 30$), 3-6 femoral pores ($\bar{x} = 4.5$), 4-4 supraoculars except for one (33807) with 5-5, and one supraocular on each side contacting the median head scales except for one (38336) with none.

Additional records in the literature (Smith, 1939) for *S. horridus* in Oaxaca are for Chazumba (just across the Puebla border southwest of Tehuacán), Huajuapán de León (on the same road as the preceding, at its junction with the Puebla-Oaxaca highway), and Cuicatlán (halfway between Tehuacán and Oaxaca, to the southeast of Tehuacán).

4. Other *S. spinosus* from within the range of *S. horridus*. Although *S. spinosus* ranges widely in south-central Oaxaca, we are aware of but two localities of record from within the range of *S. horridus* in Oaxaca. One (near

Guelatao) has already been mentioned. The other is at El Tejocote (UTA 8602, 11804-5). These specimens appear to be typical of *S. s. spinosus*, having 10-10 femoral pores in all, 27-28 dorsals and 4-4 supraoculars; the supraoculars are separated from the median head scales on both sides of one, one side of another. In Puebla, Cope (1885: 379) reported *S. spinosus* from Tlapanalá, about 13 mi N Izúcar de Matamoros. Inasmuch as Cope provided a synopsis of the genus in the same work, characterizing *S. spinosus* with 10 femoral pores, his identification is undoubtedly correct. Probable sympatry, perhaps as widespread there as in the Tehuacán area, is suggested by the specimens of *S. horridus* available from Izúcar de Matamoros (KU 43660), 4 mi E Matamoros (KU 38171), 6.5 mi SW Matamoros (KU 39631-4) and 1 mi SW Tilapa (KU 38172).

Although there is a paucity of records of occurrence of *S. spinosus* in northern Oaxaca, sufficient material is now available to demonstrate conclusively that its range in southern Puebla and northern Oaxaca broadly overlaps that of *S. horridus*, which accordingly is specifically distinct from *S. spinosus*. The difference in femoral pore number (>6 in the latter, <7 in the former) appears to be infallible, and the correlated absence of presence of contact of supraoculars with the median head scales is reliable to at least the 95% level.

B. The Subspecies Groups (Exerges) of *S. spinosus*

All members of the *spinosus* group from the state of Oaxaca, excepting *S. horridus*, *S. melanorhinus* and *S. edwardtaylori*, belong to *S. spinosus*. *S. horridus* has fewer femoral pores (<7), *S. melanorhinus* has more numerous femoral pores (>16 , all in one row), and *S. edwardtaylori* has hypertrophied supraoculars, the rear ones of which contact both the median head scales and the superciliaries. Other trenchant differences exist among these four species.

We have examined 139 specimens of *S. spinosus* from Oaxaca, as follows: vicinity of Cd. Oaxaca (UTA 8875-6; USNM 47218, 47346-8, 47534-4; AMNH 18587-97, 18753-65, 18827-43); 11 mi E Oaxaca (UCM 16795-7); 13 mi E Oaxaca (UCM 8980-8, 49666-7); 25 mi E Oaxaca (UCM 8989-93); 25 mi S Oaxaca (UCM 8994-8); 37.7 km S Oaxaca (UTA 3389); Cerro San Felipe, nr Oaxaca (UCM 41130); Cerro San Pedro, nr Oaxaca (FMNH 110587); San Felipe del Agua, nr Oaxaca (UIMNH 60447-51); Tlacolula to San Pablo Mitla (AMNH 18804-14); 3 mi W Mitla (KU 48998-45000, 40672-3); 3.7 mi NE Mitla (UTA 4323); 0.5 mi NE Suchilquitango (32 km NW Oaxaca) (UCM 16798); 0.5 mi S Guelatao (UCM 38364); El Tejocote (UTA 8602, 11804-5); Ejutla to Miahuatlán (AMNH 18598-9); Miahuatlán (AMNH 18721-5, 18822-6); 4 mi S Miahuatlán (UCM 45613-4); 6.6 mi S Miahuatlán

(UCM 48944); 6.8 mi S Miahuatlán (UCM 48945-7); 7.9 mi S Miahuatlán (UCM 48948); 15.7 mi S Miahuatlán (UCM 50724); 1 mi N Miahuatlán (UCM 22966-7); Cerro Yucuyacua, 8 km SSE Tlaxiaco (UCM 56476-84); 5.6 km WSW Tlaxiaco (UTA 2573, 2575-7, 3291).

The one variable most nearly constant geographically in these specimens and in others reported in the literature is the number of supraoculars; four (on each side) in northern localities, and five in southern ones. Four supraoculars occur on each side in all three specimens from the northernmost reported locality of occurrence of *S. spinosus* in Oaxaca, El Tejocote. These conform in all respects with the features of the nominotypical subspecies, to which they are referred. The single specimen from near Guelatao is also referred to the nominotypical subspecies. Larger series are needed from both localities to confirm these allocations, and additional material from northern Oaxaca in general is much needed to flesh out the distribution there of this species and subspecies.

South of the localities represented by *S. spinosus*, 80% of the supraocular counts (sides separate, $n = 130$) are five or six, whereas north of Oaxaca (Smith, 1939) only 22% ($n = 174$) are more than four. One geographical irregularity evident in distribution of the occurrence of four supraoculars is in the Tlaxiaco (both UCM and UTA) series of 14 specimens, in which four supraoculars occur in 50% of the 28 sides. Excluding that series, 87% of the more southern *S. spinosus* have five or six supraoculars. We interpret the Tlaxiaco series as intergrades between *S. s. spinosus*, typically with four supraoculars, and the more southern subspecies, typically with five. Another sample of intergrades is available from near Mitla (3 mi W, and 3.7 mi NE; see list). In those six specimens four supraoculars occur on both sides of two, five in the other four. A third sample of intergrades is from 25 mi E Oaxaca; two of the five specimens have four supraoculars (both sides), the others five.

The tendency in southern and central Oaxacan *S. spinosus* to have five or more supraoculars is accompanied by a high proportion (55% of 49 for which the character-state was recorded) of individuals with one or more supraoculars on one or both sides with a small lateral scale split off, giving rise to a lateral row of 1-5 small supraoculars. Such variants rarely occur in *S. s. spinosus*, and are not found in the northern Oaxacan examples here reported of that subspecies.

In all Oaxacan specimens of *S. spinosus*, the supraoculars are usually all completely separated from the median head scales (80% of 138 sides), with exceptions widely scattered geographically, although nearly half of them (12 of 28) occur in the series of nine specimens in UCM from Tlaxiaco.

It was this series, and this variation, that led Boyer et al. (1983) to conclude that intergradation of *S. spinosus* and *S. horridus* was indicated, since contacts of supraoculars and median head scales are characteristic of *S. horridus*. As shown in the preceding account, however, that character is not infallibly diagnostic of *S. horridus*; only the number of femoral pores is, in comparison with *S. spinosus*. The femoral pores of the Tlaxiaco series are typical of *S. spinosus*, 8-11 (\bar{x} = 9.7, n = 18). In addition, in a series of five from nearby, 5.6 km WSW Tlaxiaco (UTA 2573, 2575-7, 3291) not a single specimen has any supraocular in contact with the median head scales. The UCM series from Tlaxiaco appears to be anomalous in respect to its supraocular contacts.

On the basis of number of supraoculars, the central and southern populations of *S. spinosus* are justifiably regarded as taxonomically distinct at the subspecific level, with intergradation evident both east and west of the central Oaxaca highlands.

A marked geographic variation occurs within the population with more numerous supraoculars. Those in the vicinity of Cd. Oaxaca, according to Smith and Smith (1951) have more numerous dorsals (31 or more in 89% vs. 9%) and femoral pores (10 or more in 90% vs 13%) than the others; those two populations were designated *S. s. caeruleopunctatus* and *S. s. apicalis*, respectively. They constitute a 5-6 supraocular exerge distinct from the four supraocular exerge so far containing only *S. s. spinosus*.

C. *S. s. caeruleopunctatus*

Our data support the validity of two subspecies in the 5-supraocular exerge, although *S. s. caeruleopunctatus* appears to have an extremely small range in the vicinity of Cd. Oaxaca, and southward to 1 mi N Miahuatlán. Seventy-seven specimens we have examined clearly represent that subspecies: Oaxaca (49), San Felipe de Agua (5), Tlacolula to San Pablo Mitla (11), Ejutla to Miahuatlán (2), 1 mi N Miahuatlán (2), Cerro San Pedro (1), Cerro Felipe (1), 32 km NW Oaxaca (1), and 25 mi S Oaxaca (5). Only four (of 73) have 30 or fewer dorsals (28-37, \bar{x} 32.7), and only nine femoral pore counts (in 149) are 9 or fewer (7-17, \bar{x} 11.3). Several individuals have one or two extra, short rows of femoral pores (hence the record 17).

D. *S. s. apicalis*

S. s. apicalis has a range peripheral to that of the preceding subspecies, except to the north, where *S. s. spinosus* occurs. The intergrades previously mentioned with the latter subspecies involve only *S. s. apicalis*, as indicated by the frequent occurrence in them of only four supraoculars. Their dorsal and femoral pore counts, however, agree with

those of *S. s. apicalis* (as well as *S. s. spinosus*), not with those of *S. s. caeruleopunctatus*. Because at least a majority of the intergrades have five or more supraoculars, we allocate those specimens to *S. s. apicalis*. No intergradation of *S. s. caeruleopunctatus* with *S. s. spinosus* is apparent in the material examined, and probably does not occur, contrary to earlier assumption.

Localities of record for *S. s. apicalis* are as follows (numbers are given of those examined in this study); Miahuatlán (10); 4 mi S, 6.6 mi S, 7.9 mi S, 15.7 mi S Miahuatlán (8); 8 mi S, 10 mi S Miahuatlán (Smith and Smith, 1951); San Pedro Quiechapa (op. cit.); 8 km SSE Tlaxiaco (9); 5.6 km WSW Tlaxiaco (5); 3 mi W Mitla (5); 3.7 mi NE Mitla (1); 25 mi E Oaxaca (5); 37.7 km S Oaxaca (1).

The 43 specimens presently examined have 26-36 dorsals (\bar{x} 29, n = 43, 7 (16%) >30), and 7-12 femoral pores (\bar{x} 9, n = 86, 26 (30%) >9). The high frequency of femoral pore counts exceeding 9 is borderline for subspecific distinction, but the difference in dorsal scale count (5.5% with < 31 dorsals in *S. s. caeruleopunctatus*, 84% in *S. s. apicalis*) is not; respectively the femoral pore count is 6% <10 and 67% <10). In the Miahuatlán area the transition from one subspecies to the other appears to be abrupt; at one mi N Miahuatlán, the two available specimens have 31 and 32 dorsals, and 10 or 11 femoral pores, and the two specimens from between Ejutla and Miahuatlán have 32 and 33 dorsals, 10-12 femoral pores. All specimens taken north of Miahuatlán along the highway to Cd. Oaxaca appear to represent *S. s. caeruleopunctatus*, whereas those taken at Miahuatlán and southward represent *S. s. apicalis*. An exception is the specimen from 37.7 km S Oaxaca, which is clearly *S. s. apicalis* (28 dorsals, 8-8 femoral pores, 4-4.5 supraoculars).

Presumably *S. s. apicalis* occurs westward towards Tlaxiaco, since we interpret the latter as intergrades with *S. s. spinosus*, but no specimens are yet available from that little-explored area. To the northeast, the subspecies occurs at San Pedro Quiechapa (Smith and Smith, 1951), and as intergrades with *S. s. spinosus* at 25 mi E Oaxaca and near Mitla (3 mi W, and 3.7 mi NE). Those eleven intergrades have 8 sets of 4 supraoculars, 14 of 5; only 2 femoral pore counts greater than 9; and only one dorsal scale count greater than 30. They clearly do not constitute intergrades with *S. s. caeruleopunctatus*, of either *S. s. spinosus* or *S. s. apicalis*. Presumably the latter occurs in typical form in the area between San Pedro Quiechapa and Mitla, but no material from there is yet available except perhaps the specimen from 37.7 km S Oaxaca.

Incontrovertible intergrades between *S. s. apicalis* and *S. s. caerule-*

opunctatus occur 11 and 13 mi E Oaxaca. In 14 dorsal counts, 43% are <31 (26-35, \bar{x} 30.9), and in 28 femoral pore counts, 50% are <10 (7-14, \bar{x} 9.6).

The intricate interdigitation of *S. s. caeruleopunctatus*, *S. s. apicalis*, and their intergrades and intergrades of *S. s. apicalis* with *S. spinosus* east of Cd. Oaxaca (see Fig. 1) is no doubt correlated with an equally intricate interdigitation of habitats that merits study in detail. However, subspecific allocations based on series of one or two are inevitably suspect; series of six or more permit reasonably secure identifications.

Key to the Subspecies of *S. spinosus*

1. A. Supraoculars four on each side, seldom subdivided; dorsals seldom more than 30; femoral pores usually (83%) no more than 9 on each side, rarely more than 10 (3%) *spinosus*
- B. Supraoculars 5-6 on each side, usually subdivided (*Sceloporus spinosus* exerge *caeruleopunctatus*) 2
2. A. Dorsals usually no more than 30; femoral pores usually no more than 9 on each side *apicalis*
- b. Dorsals usually 31 or more; femoral pores usually 10 or more, occasionally in 2 or more rows *caeruleopunctatus*

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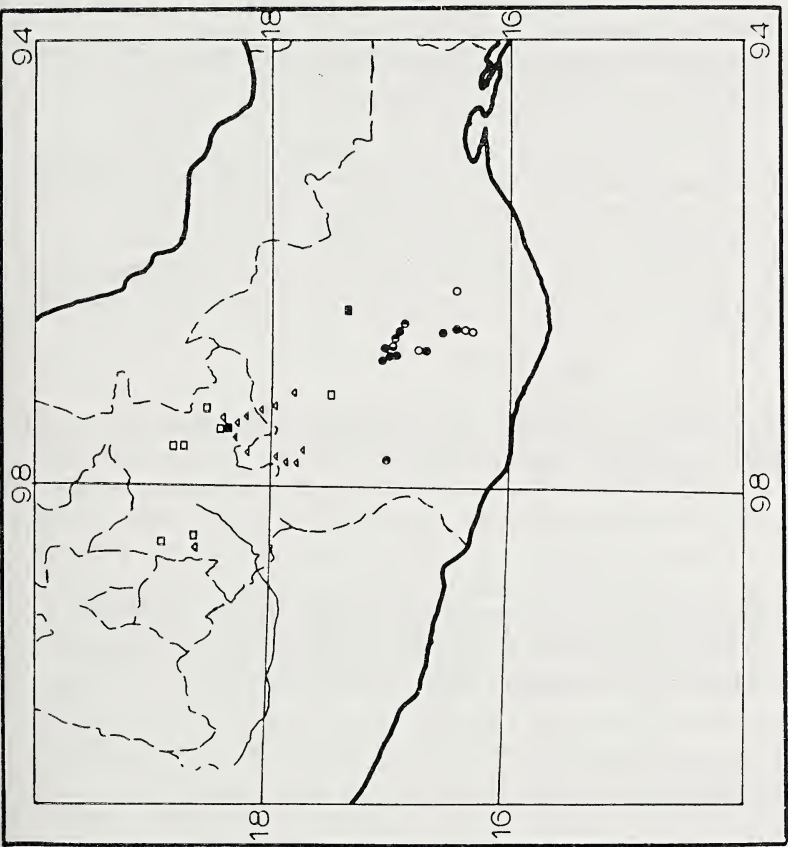


Fig. 1. Localities of record for *Sceloporus h. horridus* (triangles), *S. s. spinosus* (squares), *S. s. caeruleopunctatus* (dots) and *S. s. apicalis* (circles) in southern Puebla and in Oaxaca, Mexico. Sympatry, *S. s. spinosus* and *S. h. horridus*, solid squares. Intergrades, *S. s. apicalis* and *S. s. spinosus*, circles half shaded on right. Intergrades, *S. s. apicalis* and *S. s. caeruleopunctatus*, circle half shaded on left.

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A REDESCRIPTION OF THE LARVAE OF *RANA MONTEZUMAE* (ANURA: RANIDAE)

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Larvae of the Mexican frog *Rana montezumae* are redescribed. Most features do not differ appreciably from the description by Taylor (1942). The tooth-row formula of most larvae is 2(2)/3(1). Features of note in our sample of 30 tadpoles from near Ibarra, Guanajuato, include occurrence of a narrow P-1 medial gap (73%), a relatively short P-3 row about 63 percent the length of the P-2 row, an A-3 row never present, a wide A-2 medial gap (wider than either lateral segment), and occasional (23.3%) complete absence of the A-2 row.

Introduction

Taylor (1942) first described the larvae of *Rana montezumae* based on two samples, one of 35 from the Distrito Federal containing both pre and post metamorphic individuals, the other of 9 tadpoles from the state of Mexico containing both "young and half grown" individuals. He described in detail a single larva of 112 mm total length from the larger sample; his illustration of this larva in lateral view (1942:55, fig. 1) depicts well developed hindlimbs, but no exposed forelimbs, that mark stage 42. Altig and Johnston (1986) listed this same larva at stage 36, which appears too early to judge from the hindlimb digits of Taylor's figure. Taylor also illustrated the oral apparatus of this one larva (1942:55, fig. 5), and remarked about its papillae, musculature, and color pattern. The tooth row formula of 2(2)/3, discerned from Taylor's figure, agrees with that listed by Altig and Johnston for *R. montezumae* tadpoles. Although Taylor included comments about individuals other than the illustrated larva, they are of a cursory nature, and statistical data were not employed.

The purpose of this study is (1) to provide descriptive and statistical data on the morphology of 30 tadpoles of *R. montezumae*, and (2) to offer some characters that in combination will hopefully aid in identifying larvae of *R. montezumae*.

Materials and Methods

A lot of 30 tadpoles (UTEP 7509, Laboratory for Environmental Biology, The University of Texas at El Paso) was seined by one of us (Webb)

and Peter Dalby, 20 July 1966, from a large shallow pond (maximal depth about 76 cm or 2.5 ft.) having abundant aquatic vegetation and aquatic insects. In addition to the ranid tadpoles, six salamander (*Ambystoma*) larvae (UTEP 7508) and one transformed ranid frog identified as *Rana montezumae* (Michigan State University Museum, Number 9587) were obtained at this pond site. The site of collection is on the property of Rancho La Puerta Guadalupe, about nine air kilometers southwest Ibarra, about 2560 m (8400 ft.), Guanajuato (near Jalisco border), Mexico.

Larvae were staged according to Gosner (1960). Descriptive features follow Altig (1970) and Scott and Jennings (1985). Measurements of body length, tail length, tail musculature height, tail height, dorsal and ventral fin height, interocular and internareal distance, were made with Cenco calipers to the nearest mm, whereas those of "tooth" rows that include A-1 length, left and right A-2 lengths, A-2 gaps, and lengths of P-1, P-2, P-3 and P-1 gap, and mouth width, were made with a binocular dissecting microscope and ocular micrometer calibrated to the nearest 0.1 mm. These morphometric characters were recorded for each of the 30 larva (missing or damaged parts in some individuals). Collective data for each character were subjected to univariate statistical analysis using an IBM personal computer and Axum (1989) statistical program, version 1.01. Descriptions of color pattern, thickness of the rectus abdominis muscle, body shape, lateral line system, and orbitonasal canal, follow Scott and Jennings (1985).

Description

Our 30 larvae vary from 32.0 to 87.0 mm in total length in developmental stages 27 to 41; the relationship of total length and stage of development are correlated in Table 1 (a correlation coefficient between these two variables was determined as $r = 0.95$). A scattergram (Fig. 1) shows a positive correlation between developmental stage and body length. The relative lengths of body and tail do not seem to vary with increasing size; tails are longer than bodies with the ratio tail/total length in 30 larvae varying from 0.55 to 0.63 (\bar{x} , 0.588). The data for the 20 characters used in this study are indicated in Table 2. The body shape in dorsal view is bluntly triangular anteriorly with slight indentations posterior to the eyes that tend to separate the head from the abdomen at the anterior terminus of the dorsolateral muscles; this separation is obvious in lateral view, especially in the larger larvae. The proximal tail musculature is thick and robust.

Color and pattern - Live tadpoles show considerable variation in colors and patterns within the same species due to ontogenetic and environmental variables. Hillis (1982) noted the effects of environmental factors on morphological features of both field-collected and laboratory-

Table 1. Relationship of size (total length) and Gosner stages of development in larvae of *Rana montezumae*; data are stage, sample size, mean, and range (mm).

27	2	34.5	32-37
28	2	39.5	35-44
29	1	45.0	45
30			
31	4	49.5	48-53
32	1	47.0	47
33	2	55.0	54-56
34	3	60.6	54-67
35	2	62.5	61-64
36	2	69.0	67-71
37	4	80.5	76-87
38	2	73.0	73
39	1	82.0	82
40	3	81.3	79-84
41	1	84.0	84

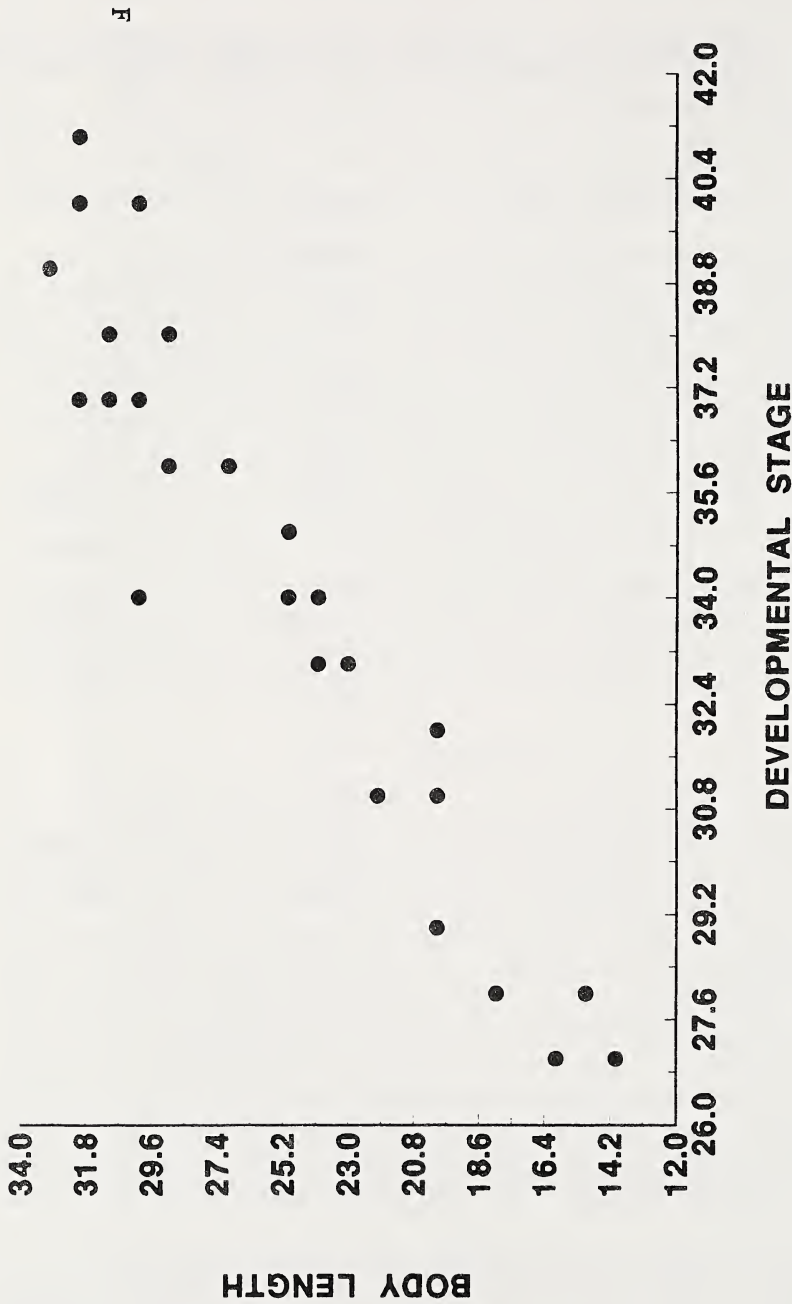


Fig 1. Relationship of developmental stage and body length in 30 larvae of *Rana montezumae* (some similar values share same symbol).

Table 2. Comparison of Means \pm 1 SD and Ranges of 20 Morphological Characters of Field-collected *Rana montezumae* Larvae, N = 30, except as indicated.

Character (in mm) (except #20)	\bar{x}	± 1 SD	(range)
1. Body length	25.30	± 5.62	(14.0-33.0)
2. Tail length	37.07	± 10.93	(18.0-57.0)
3. Total length	62.37	± 16.33	(32.0-87.0)
4. Tail musculature height	7.77	± 2.56	(3.0-12.00)
5. Tail height	14.03	± 3.60	(7.0-19.0)
6. Dorsal fin height	4.93	± 1.41	(3.0-9.0)
7. Ventral fin height	3.80	± 1.0	(2.0-6.0)
8. Interocular distance	4.97	± 1.47	(3.0-9.0)
9. Internareal distance	3.43	± 0.68	(2.0-5.0)
10. A-1 tooth row length	3.41	± 0.82	(2.1-5.0)
11. Left A-2 tooth row length	0.46	± 0.36	(0-1.3)
12. Right A-2 tooth row length	0.41	± 0.35	(0-1.3)
13. A-2 median gap width	1.34	± 1.0	(0-3.0)
14. A-2 gap ration (N=21)	0.37	± 0.19	(0.17-0.87)
15. P-1 tooth row length	2.96	± 0.73	(1.8-4.2)
16. P-2 tooth row length	2.99	± 0.73	(1.9-4.1)
17. P-3 tooth row length (N=29)	1.89	± 0.61	(0.6-2.7)
18. P-1 median gap width (N=22)	0.12	± 0.09	(0.1-0.5)
19. Mouth width	3.41	± 0.83	(2.1-5.0)
20. Stage	34.30	± 4.13	(27-41)

reared larvae. Preserved tadpoles in formalin lose much of their color due to leaching, but retain melanin patterns in varying degrees. Scott and Jennings (1985) reported that the body wall of preserved tadpoles of both *R. blatri* and *R. pipiens* becomes transparent, thus exposing the underlying melanin pattern of either the peritoneum, the rectus abdominus muscle, or the intestine. They used color and pattern to partly distinguish larvae of five species of New Mexican leopard frogs.

Our preserved tadpoles of *R. montezumae* show variable retention of melanin depending on size. Small tadpoles tend to have clear, patternless tails, with reduced melanin in the body and tail musculature, and have indistinctly outlined body and tail myomeres. Features of color and pattern are best developed in the large tadpoles that have the body dorsum and sides dark gray with distinctly outlined dorsolateral myomeres; the venters are generally clear or light gray with the intestines visible. The pale yellow tail musculature has distinct, mostly patternless, myomeres anteriorly, but a fine mottling of coalesced dots and flecks posteriorly. The fins, clear anteriorly, have spots and flecks, and in some larvae a guanic reticulation, posteriorly with the pigmentation often most intense in the lower fin.

Lateral line organs and orbitonasal canal - These features were observed at 7-10x magnification under water with a binocular dissecting microscope. The orbitonasal canal is visible only in large tadpoles (stage 38-41). The lateral line system seems to be mostly absent even in the large tadpoles; only parts of the dorsal and lateral branches are evident as discontinuous stretches of pellucid dots.

Oral disc - The sides of the oral disc are emarginate. The configuration of oral papillae and the horny beak do not differ appreciably from the description by Taylor (1942); the papillae, pigmented or not, are small and sparse inside the corners of the mouth. The tooth-row formula applicable to most larvae is 2(2)/3(1). The length of the A-1 tooth row is about the same length as the width of the mouth. The A-2 tooth row is variable. Both right and left segments are separated by a wide and variable median gap (wider than either lateral segment) in 21 of 30 larvae (70%) for which the mean A-2 gap ratio is 0.370 (0.17-0.87). In two larvae (6.6%) only the right or left segment of the A-2 row is present (absent on other side), whereas seven larvae (23.3%) lack both right and left segments (A-2 row absent). This variation in the A-2 row does not seem to be correlated with the stage of development (Table 3). None of our larvae has a third upper tooth row (A-3). A narrow medial gap (only 0.1 to 0.5 mm) in P-1 in 22 of 30 larvae (73%) is not indicated by Taylor (1942) or Altig and Johnston (1986). The third lower tooth row (P-3) is noticeably shorter than P-1 or P-2 (about same length), as depicted by Taylor (1942: 55, fig. 5). One larva of 30 lacks a P-3

Table 3. Number of tooth rows in upper labium (A-1, A-2) showing variation in A-2 (1.5, one segment absent; 2+, both segments present; 2-, both segments absent).

Stage	N	Numbers of tooth rows			
		1	1.5	2(+)	2(-)
27	2	2	1 right	1	
28	2	2		2	
29	1	1		1	
30					
31	4	4	1 left	2	1
32	1	1			1
33	2	2		1	1
34	3	3		3	
35	2	2		2	
36	2	2			2
37	4	4		3	1
38	2	2		1	1
39	1	1		1	
40	3	3		3	
41	1	1		1	

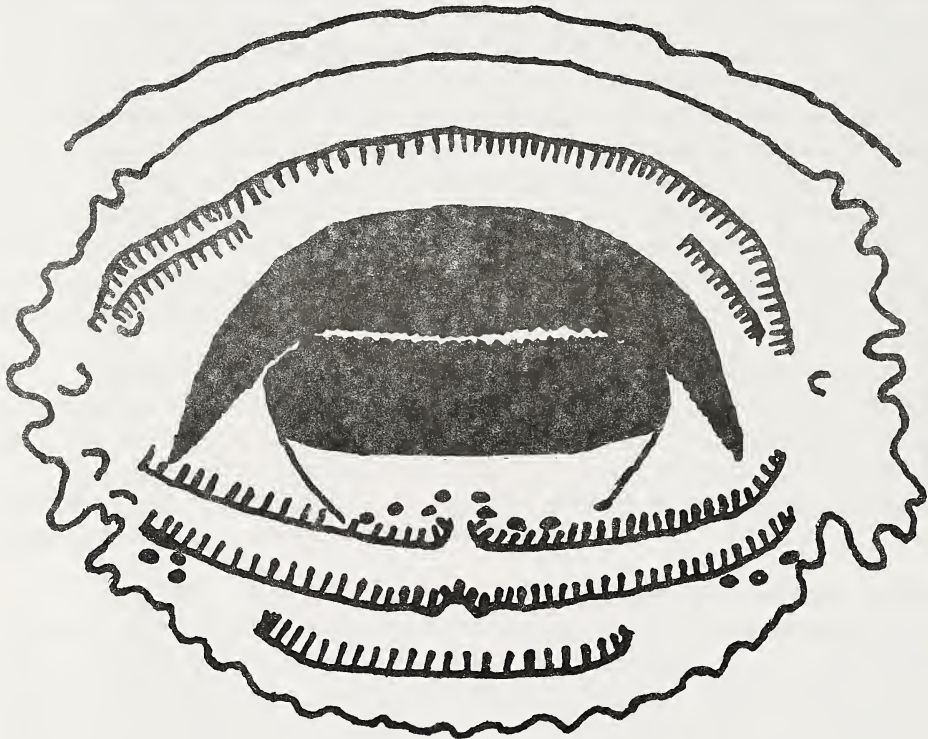


Fig. 2. Oral disc of larva of *Rana montezumae*, Gosner stage 34, 54 mm total length (UTEP 7509)

row. The mean length of the P-3 row in 29 larvae is 1.89 (0.6-2.7) mm compared to 2.99 (1.9-4.1) mm for the P-2 row in 30 larvae, or the mean length of row P-3 is about 63 percent the length of P-2. The oral disc of *R. montezumae* is illustrated here in Figure 2.

Comparisons

Detailed descriptions of anuran larvae have purpose when they can be ultimately used for comparison by future investigators. Suitably detailed descriptions are not available for taxa of frogs of the *Rana pipiens* complex from areas of sympatry or near allopatry with *R. montezumae*. Despite the geographical disparity of the larval samples, our data are in general agreement with that of Taylor (1942) and suggest the following combination of characteristics of *R. montezumae* as possibly useful in comparing larvae of frogs of the *R. pipiens* complex (based on comparative data in Scott and Jennings, 1985): (1) the relatively dark-blotched pigmentation posteriorly on tail, (2) an A-3 tooth row never present, (3) a wide A-2 gap (wider than either lateral tooth-row segment), (4) occasional absence of the A-2 row, (5) the relatively short length of row P-3. When compared to larvae of the five species of the *R. pipiens* complex from New Mexico (Scott and Jennings, 1985), the features of *R. montezumae* most closely match those of *R. chiricahuensis*, and thus support inclusion of these two species in the *R. montezumae* species group (Hillis et al., 1983; 1988).



Fig. 3. Representative larvae showing features of color and pattern best developed in larger tadpoles (UTEP 7509). Scale equals 40 mm.

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AN ALBINO *THAMNOPHIS SIRTALIS* FROM FAIRFIELD COUNTY, SOUTH CAROLINA

Instances of albinism in *Thamnophis sirtalis* have been reported numerous times in the literature. Dyrkacz (1981) cites at least seven examples of albinism in this species in the SSAR Herpetological Circular No. 11: *Recent Instances of Albinism in North American Amphibians and Reptiles*.

On September 1, 1991 an albino *T. sirtalis* was collected in a residential area of Fairfield County, South Carolina by a local individual and presented to the Riverbanks Zoological Park, Columbia, South Carolina for identification. The specimen, an adult female, is ca. 66 cm in length and exhibits similar coloration as a juvenile collected by Cope and Kashner near Dansville, Montour County, PA during 1974 and reported by Groves [(1976) Bull. Maryland Herp. Soc. 24: 21-22].

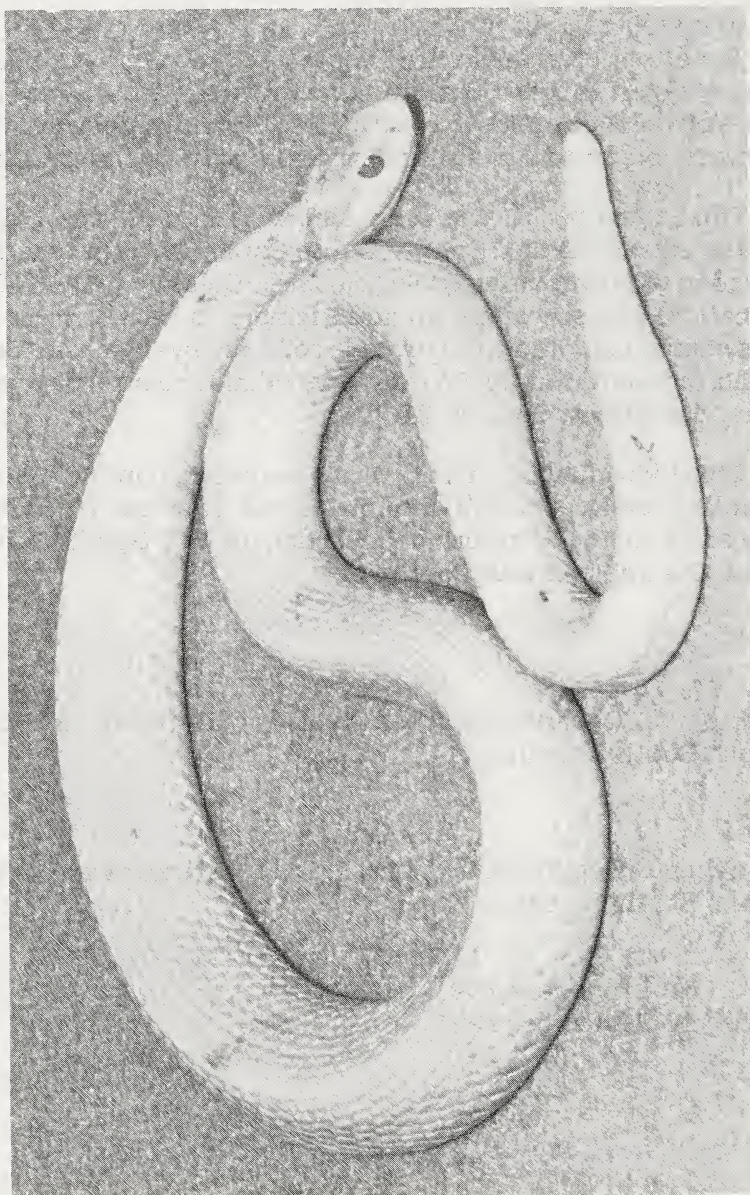
This individual is currently being maintained in the collection of the Riverbanks Zoological Park, Columbia, South Carolina. Upon death, it will be deposited in the Vertebrate Collection of the South Carolina State Museum, Columbia, South Carolina.

—*Chuck Smith*, Department of Herpetology, Riverbanks Zoological Park, Columbia, South Carolina

—*Kyle Schuett*, Department of Herpetology, Riverbanks Zoological Park, Columbia, South Carolina

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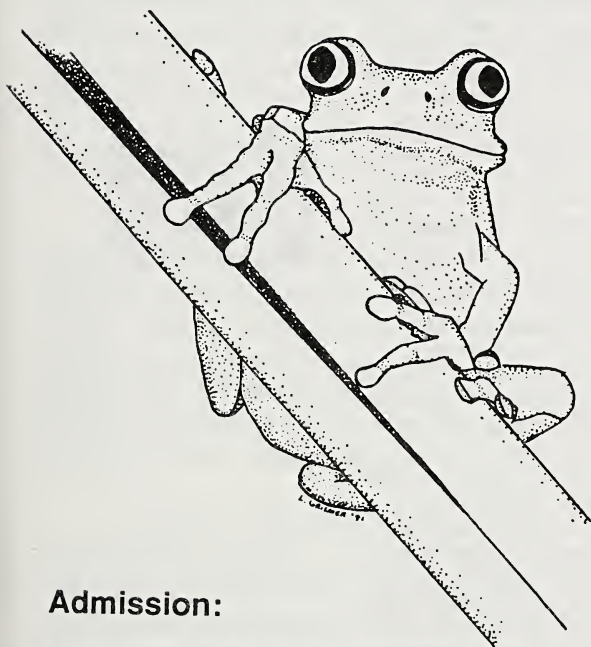
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NOTES

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Carl H. Ernst is professor of biology at George Mason University, Fairfax, Va. He has written four books, including the award-winning *Turtles of the World* (Smithsonian Institution Press, 1989).

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DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.



MDHS.....A FOUNDER MEMBER OF THE
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30 SEPTEMBER 1992

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Volume 28 Number 3

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The Maryland Herpetological Society
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"SHOULDERING" IN PRAIRIE RATTLESNAKES: A NEW HYPOTHESIS¹

David Chiszar, Jason Perelman, Hobart M. Smith and David Duvall

Prairie rattlesnakes were tested with kingsnake chemical cues in either a pen or an artificial burrow. The dependent variable was frequency of body-bridging responses. More responses occurred to these chemical cues in the burrow situation than in the pen. Further, body bridging in the burrow can (1) give the rattlesnake firm purchase against the walls, and (2) seal the passage ways. Both factors could discourage predatory attempts by kingsnakes. Accordingly, we hypothesize that body bridging might be adaptively associated with crevice and burrow situations, and this response might be better studied in these situations than in open arenas.

Crotaline snakes exhibit a specialized reaction to kingsnake predators (Cowles, 1938; Klauber, 1927), triggered by chemical cues associated with the integuments of these ophiophagous snakes (Bogert, 1941; Weldon & Burghardt, 1979). This behavior has received several names (e.g., shouldering, kingsnake defense posture, body bridging, inverted U), but all investigators agree in describing its essential features: "A body bridge starts from a normal laterally projecting loop of a portion of the trunk of the snake in resting positions and rises from the substrate. As the body bridge rises, the dorsoventral plane of the trunk region involved is tipped or tilted medially, thus presenting the ventral surface or belly laterally to the outside of the body bridge" (Carpenter & Gillingham, 1975, p. 295; see this article for many additional details and for excellent drawings). Other behaviors occur along with body bridging (e.g., inflation of the trunk, jerking movements of the trunk and of the raised bridge), apparently augmenting the display (Carpenter & Gillingham, 1975; Klauber, 1956).

¹The behavior here under study has been called body bridging for many years, and we use this term in the text. The word "shouldering" is used in the title, however, to recognize our debt to Dr. Charles M. Bogert, with whom we have corresponded during the conception and execution of this study. Dr. Bogert's (1941) contribution to this line of research is well known; indeed, it is a classic paper in herpetological ethology. Dr. Bogert has long referred to our target behavior as "shouldering", and we take pleasure in acknowledging our interaction with him by using his term in our title. Our text will make clear, however, that we are making no attempt to supplant the nomenclaturally-stable term body bridging.

Although there is no doubt about the reality of body bridging, the behavior is quite variable in that some individuals exhibit it readily while others do not; also, snakes that perform the behavior during initial stimulation frequently quit responding after a few trials (Bogert, 1941; Gutzke, 1991). As far as we are aware, no one has explained this variability or has developed a paradigm that eliminates it (although Gutzke, 1991, hypothesized that size of the crotaline is inversely correlated with frequency of body bridging to a kingsnake stimulus). This could mean that all studies of body bridging have used suboptimal setting conditions and that alternative conditions could give rise to less variability in the behavior.

A characteristic common to all studies of body bridging has been that crotaline snakes were tested in arenas with little or no cover available. This fact became salient to the authors when we were collecting prairie rattlesnakes (*Crotalus viridis*) along sandstone outcrops near Agate, CO. One snake, a large female, managed to get half of her body into a crevice before we got our Pilstrom tongs on her. Although we captured this animal, approximately 20 minutes were required to dig her out. During the digging we saw that the snake's body was bridged at several points and these bridges were pressed firmly against walls of the sandstone tunnel. Such appositions made the animal very difficult to remove, and at particularly narrow points in the tunnel the passage was completely obstructed by them. These observations led us to hypothesize, perhaps iconoclastically, that body bridging might be a behavior of greater utility to crotaline snakes in burrows or crevices than to the same snakes above ground. Indeed, it has never been abundantly clear that body bridging by a crotaline in an arena situation could actually deter a large kingsnake bent on eating the crotaline (see Klauber, 1956, for a different opinion; and see Carpenter & Gillingham, 1975, for an alternative hypothesis). On the other hand, it was our impression during the Agate collecting trip that a kingsnake would not be able to enter the rattlesnake's lair because it was effectively sealed by the bridges. Furthermore, a kingsnake with a mouth grip on the rattlesnake's midsection or rear would not be able to pull the firmly anchored prey out of the burrow.

To test these ideas we constructed an artificial burrow and compared the elicibility of body bridging in rattlesnakes confined to the burrow with the elicibility of this behavior in snakes living in a pen that was comparable to arenas used in previous studies. If body bridging is a response that is especially effective in burrows, then we ought to see this behavior more frequently in rattlesnakes tested in the burrow than in snakes tested in the pen. To standardize the test, we use kingsnake chemical cues (presented on rods and cotton-tipped applicators) as stimuli rather than kingsnakes themselves. Whereas it would be difficult (perhaps impossible) to control the

behavior of a live kingsnake in the pen or the burrow, we could control precisely the movement and position of the rods and applicators.

Methods

Eight *C. viridis* (adult, long-term captives) were observed. Four were confined, individually, in the burrow (Fig. 1), and four were confined, individually, in a plywood pen (60 x 66 x 81 cm). A rattlesnake was placed into its test situation two days prior to the first observation. On day three, five tests were administered: (1) the tip of a plastic rod that had been rubbed along the back of a kingsnake was brought with 2 cm of the rattlesnake's face, (2) a cotton-tipped applicator that had been rubbed along the back of a kingsnake was brought within 2 cm of the rattlesnake's face, (3) the tip of a control plastic rod that had been dipped in tap water was brought within 2 cm of the rattlesnake's face, (4) a cotton-tipped applicator that had been dipped in tap water was brought within 2 cm of the rattlesnake's face, and (5) no disturbance. Tests were administered in random order with 30 min separating successive trials. Each test was 60 sec long, with the rod tip or applicator being moved as necessary to keep it within 2 cm of the rattlesnake's face. This entire five-trial procedure was replicated five times at 24-hr. intervals. Hence, each snake had a total of 25 tests, five with each stimulus. The dependent variable was presence versus absence of at least one body-bridging response during each test.

Two kingsnakes (one *Lampropeltis getula splendida* and one *L. g. californiae*) were used as chemical cue donors. They were maintained in separate cages (62 x 32 x 32 cm), and neither had ever been brought into contact with the *C. viridis* used in this study. The kingsnakes were used equally often as chemical donors for each of the rattlesnakes. Chemical cues from the two kingsnakes were equally effective in eliciting body bridging responses ($F < 1$), so data were pooled across this factor and it will not be discussed further.

When a snake was removed from the pen or the burrow, the apparatus was cleaned with water and towed dry. A new snake was installed, and another two-day acclimation period passed before observations commenced.

The laboratory was maintained at 26°C by electric heaters and the photoperiod (0700-1900) was automatically controlled. All snakes normally lived individually in glass terraria (62 x 32 x 32 cm) containing paper floor covers and a stainless steel vessel filled with water. Feeding occurred once per fortnight (one mouse, *Mus musculus*, 20 g). Snakes were fed prior to being

placed into the experimental apparatus and were not fed while they were in it.

Results

Body bridging was never seen during trials involving no disturbance, and this behavior was rarely seen with control applicators or with the control rod (Table 1). On the other hand, body bridging was frequently observed when kingsnake chemical cues were introduced (Table 1). Data for each snake were summarized by calculating percent of trials for each stimulus that contained a body-bridging response. Each of these five percents were then averaged over snakes in the burrow condition and in the pen condition. Analysis of variance then treated conditions (pen versus burrow) as a between-subjects factor and stimuli as a repeated-measures factor. Because percentages are frequently distributed in a skewed manner, we applied the ANOVA not only to the percents but also to arcsins and probits, commonly used transformations (Winer, 1971). All the ANOVAs revealed similar patterns of effects, and we here report the outcome of the probit analysis. Not surprisingly, the effect of stimuli was significant ($F = 6.66$, $df = 4,24$, $P < 0.01$). Post hoc contrasts revealed that kingsnake chemical cues on rods and applicators were equally likely to generate body bridging, and both types of tests had significantly more bridging responses than did the control or undisturbed trials (which did not differ among themselves).

Rattlesnakes in the burrow environment emitted more body bridging responses than did snakes in the pen (main effect of burrow vs pen: $F = 3.95$, $df = 1,6$, $0.10 > P > .05$). More important, since this difference between burrow and pen was restricted to rods and applicators containing kingsnake chemical cues, the ANOVA produced a significant interaction between burrow vs pen and stimuli ($F = 3.56$, $df = 4,24$, $P < 0.05$).

Discussion

These data support the hypothesis that body bridging by prairie rattlesnakes is more likely to be seen in burrows than in open areas such as our pen. It is noteworthy that several of the bridging responses seen in the pen involved the rattlesnake looping its body against a wall, as if the snake was attempting to gain purchase. This was very similar to the body bridges seen in the burrow. Most important, body bridges in the burrow had the effect of pushing the snakes' bodies against several walls simultaneously, and this would make the snakes difficult to pull out of the burrow. The

Table 1. Mean percent of trials containing body bridging responses (standard error) in each stimulus condition for rattlesnakes tested in the pen and in the burrow.

	Rod with kingsnake chemical cues	Applicator with kingsnake chemical cues	Control Rod	Control Applicator	Undisturbed
Pen	20.0 (20)	20.0 (20)	0.0 (0)	0.0 (0)	0.0 (0)
Burrow	58.3 (25)	45.0 (26)	10.0 (6)	0.0 (0)	0.0 (0)

passages inside of the burrow were relatively spacious, being two-three times larger than the snakes' largest diameters. Even so, there were episodes of bridging in which passages were effectively closed. Burrows with smaller passageways would almost always be closed by the behaviors seen in the present study.

Accordingly, we urge other investigators interested in body bridging to consider burrows as test situations. It might be necessary to experiment with various designs and to examine snake preferences for tunnel shapes,

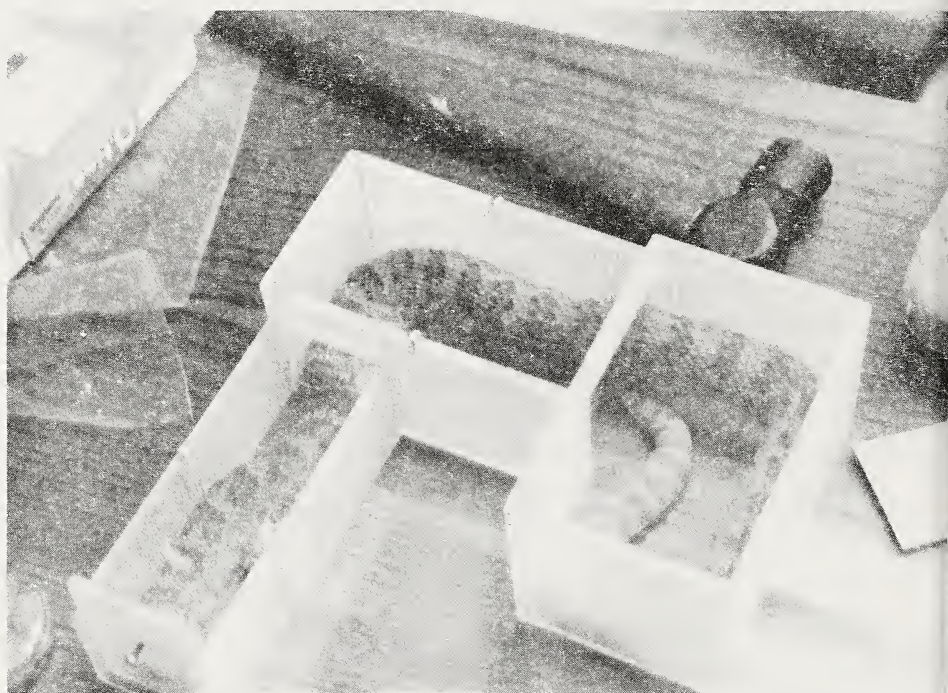


Fig. 1. The Plexiglas burrow used in this experiment. A bridge can be seen pressed against the rear wall of the apparatus. The snake had, moments before, been stimulated with a cotton-tipped applicator containing chemical cues derived from a kingsnake (see text).

sizes, and opacity. However, with a well designed burrow system, body bridging should become an increasingly frequent response to kingsnake cues, and, perhaps, to other subterranean threats. If this proves to be correct, then it may eventually become reasonable to connect subterranean body bridging with Barbour's (1926) description of phragmosis in several anurans and in Uropeltid snakes.

Finally, there is no question that chemical cues were effective in eliciting body bridging (Bogert, 1941). We do not know if a live kingsnake would elicit a greater frequency of body bridging than did the chemical cues, although this is certainly possible. Nevertheless, the present study adds to the growing body of evidence that points to chemical signals as being crucial components in the release of body bridging and the recognition of ophidian predators (Dial et al., 1989; Weldon, 1982; Weldon & Burghardt, 1979).

Acknowledgment

We thank Drs. S. Mackessy and J. Clarke for the loan of the *L. g. splendida* used in this project. An oral account of these data was presented by Chiszar et al. (1991) at the SSAR-HL symposium in honor of Roger Conant. We are grateful to Dr. Conant and to the symposium organizers (K. Adler, J.T. Collins, & J.B. Murphy) for this opportunity.

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RATTLE LENGTH IN *CROTALUS HORRIDUS ATRICAUDATUS*

Authentic reports of wild caught rattlesnakes with rattle strings greater than fifteen segments in length are scarce. Klauber (1956) cites a number of descriptions regarding the occurrence of strings of 40 to 70 segments but obviously questions their validity. Klauber also states "Of the many thousands of rattlers than have been brought to the San Diego Zoo in the past twenty-five years, none has had more than sixteen segments in its rattle". With the exception of a twenty-three segment string reportedly taken from a *Crotalus atrox*, the longest incomplete string from a wild caught rattlesnake examined by Klauber was sixteen segments. Captive raised animals may routinely acquire strings of ten or more segments as wear and usage in such situations is minimal.

On 1 May 1990, a 135 cm *Crotalus horridus atricaudatus* was taken at approximately 2130 hours while crossing route 336 in Jasper County, South Carolina. The specimen weighted approximately 1.8 kg and had an incomplete rattle string of nineteen segments. Rattle dimensions were length: 10.1 cm; width (at segment nine): 1.52 cm; thickness (at segment nine): .63 cm. The specimen is temporarily being maintained in the private collection of CFS.

-Charles F. Smith, Department of Herpetology, Riverbanks Zoological Park, P.O. Box 1060, Columbia, South Carolina, Current address: Department of Herpetology, Arizona-Sonora Desert Museum, Tucson, Arizona.

Received: 20 January 1992

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NEW DATA ON HATCHLING MUD SNAKES, *FARANCIA ABACURA REINWARDTII* SCHLEGEL

Harold A. Dundee

A field-hatched litter of mud snakes (*Farancia abacura reinwardtii* Schlegel) shows the size of hatchlings to exceed previously reported measurements for the species. A compilation of meristic counts updates values available for both races of the species and calls attention to discrepancies in reported counts due to different counting techniques.

Mud snakes have one of the latest hatching seasons of any U.S. snake species, most eggs hatching from September to October 30. On 10 October 1991 I found in a rotted log in a woods near Boutte, St. Charles Parish, Louisiana, 24 newly hatched mud snakes, one egg containing an unhatched, stillborn snake, and 34 empty egg shells. All of the hatchlings had a milky hue because they were about to molt the skin. Meristic and measurement data on this litter provide more extensive information than previously reported. The specimens have been deposited in the Louisiana State University Museum of Natural Science as LSUMZ 53626-53650.

The first comprehensive review of the meristics of the species was provided by H.M. Smith (1938) who resurrected the division of the species into two races, *Farancia a. abacura* and *F. a. reinwardtii*. He found no significant meristic differences in the two races; the distinction is made on the basis of coloration. The next summary of meristics by Wright and Wright (1957) repeated Smith's values. Hahn and Wilson (1966) gave data on two clutches of *F. a. reinwardtii* taken in the field September 11 and hatching from September 15 to a few days thereafter. They found more extensive values for numbers of ventrals and subcaudals, and ratio of tail to total length than previously reported. They noted that morphological variation in juveniles was greater than that in adults and that such was to be expected inasmuch as Dunn (1942) indicated that varietal characters may have differential survival value. Mount (1975) considered that no notable variation existed between the races in ventral and subcaudal counts and gave values for the combined figures for Alabama specimens. The smallest number of ventrals (163) given by Mount is four less than that given by H.M. Smith (1938) or Hahn and Wilson (1966). The most recent summary of meristics is provided by Ernst and Barbour (1989). Unfortunately this latter

report does not incorporate all of the extremes given by Mount and by Hahn and Wilson, even though those papers are listed in its bibliography. Both Smith (1938) (pers. comm.) and Ernst and Barbour (1989) used an older system of counting ventral scutes, i.e., the first ventral being interpreted as the first widened ventral scute. Most systematists now usually use the Dowling (1951) system, in which the first ventral scute is the first one bordered on either side by the first row of dorsal scutes. Counts on *Farancia* that employ the Dowling system will usually result in a count of 3 fewer scutes than in the older system.

The following is a summary of values obtained from the 13 males and 12 females from the St. Charles Parish litter. Means are given in parentheses.

	males	females
S-V length in mm	189-218 (203.5)	207-241 (221.3)
Total length in mm	226-250 (237.8)	237-272 (251.1)
Tail/total length	14.6-16.6 (15.8)	11.4-12.7 (11.9)
Ventrals	170-177 (172.8)	190-195 (192.5)
Subcaudals	47-51 (48.8)	36-39 (37.3)

The ventral count was made using the Dowling (1951) system. Subcaudals were counted using the first large subcaudal behind the cloacal scute (=anal plate; see Dundee, 1989) contacting a large subcaudal on the opposite side, and not including the terminal spine. Hahn and Wilson (1966) used the Dowling system. Mount (1975) used the Dowling system, thus his figure of 163 for males would be the lowest reported ventral count for the species (1 or 2 fewer). P.W. Smith's (1961) count for females (167) constitutes the lowest value for the species. I cannot determine from Smith (1961) or other papers that he published if he used the Dowling system. If he used the pre-Dowling method, the count could be circa 164.

I determined the number of ventral scutes between the umbilical opening and the cloacal scute as did Hahn and Wilson (1966). Determining just where the umbilical opening ended is difficult because the degree of closure varied, but many of the specimens I examined had far fewer scutes (males 17-24, \bar{x} 21.5; females 23-29, \bar{x} 26) between umbilicus and cloacal scute than the minimum 24 reported by Hahn and Wilson. Although male

and female counts overlapped slightly, my litter, like Hahn and Wilson's, showed sexual dimorphism.

Subcaudal counts are ordinarily understood to exclude the terminal spine. For the species, the lowest count for males is 36 reported P.W. Smith (1961), lower than the 38 given by Hahn and Wilson (1966) and substantially lower than the 44 reported by other workers. For females the count of 50 given by Hahn and Wilson is the highest value reported.

For the race *Farancia abacura reinwardtii*, the only one for which ample data are available, the known range for ventrals, using the Dowling system and interpolating H.M. Smith (1938) and Ernst and Barbour (1989), would be males 163-177; for females 167-205, perhaps 164-205. Subcaudal count for the race (assuming that the terminal spine was not included) is 36-55 for males, 35-50 for females. Values for *Farancia a. abacura*, interpolating from Smith (1938), would be ventrals in males 167-177, in females 186-196, and subcaudals 31-43.

In H.M. Smith (1938) the ratio of tail length to total length revealed a 100% sexual dimorphism; in males of either race the tail was longer than in females, with no overlap of ratio either for the species or the races. Hahn and Wilson (1966) found an overlap, but on the whole males had longer tails. In my litter sexual dimorphism was present, with no overlap. But P.W. Smith (1961), who commented on Illinois *reinwardtii*, found that the three females he examined all had proportionally longer tails than any of the four males he examined. His values are so different from those found by H.M. Smith, Hahn and Wilson, or me that one must suspect that his figures were reversed.

If the P.W. Smith (1961) values for tail ratio are ignored, the tail length as a percentage of total length values, taking into account the Hahn and Wilson (1966) figures, are for the species, males 11.9-18.9 % compared with 14.1-18.2 % given by H.M. Smith (1938), females 8.2-16.8 % compared with 8.2-13.8 %. For *Farancia a. reinwardtii*, the values are males 11.9-18.9 % (cf Smith's 15-18.2 %), females 10.1-16.8 % (cf Smith's 10.1-13.2 %). Values for *Farancia a. abacura* remain as the Smith figures. If P.W. Smith's (1961) figures are considered, the tail ratio for the species is males 10.7- 18.9 % and females remain at 8.2-16.8 %. For *F. a. reinwardtii*, male values are 10.7- 18.9 % and females remain at 10.1- 16.8 %.

Head scutellation also deserves comment. Ernst and Barbour (1989) stated temporals 2-2, but H.M. Smith (1938) stated usually 1+ 2, occasionally 1+1+2 or 1+3. Hahn and Wilson (1966) also said usually 1+2, but that the second row of temporals may be broken into several scales. In the litter examined by me, 10 specimens had a count of 1+1, only 2 were interpreted

as 1+2, 9 were determined as 2+2, and the remaining 3 were 3+3, 2+1 (the posterior one was in slight contact with the postocular), and 0-1-2 as judged by size. Obviously the Ernst and Barbour statement does not accommodate the great variability in temporal count.

Ernst and Barbour (1989) gave the typical labial count as 7 supralabials, 8 infralabials; H.M. Smith (1938) gave 7 supralabials as the usual, as did Hahn and Wilson (1966), and in my litter only one was other than 7-7, being 8-7. But Smith (op. cit.) said infralabials usually 9, Hahn and Wilson (op. cit.) said 9-9 (70%), 8-9 or 9-8 (17%), and 8-8 (13%). P.W. Smith (1961) gave the typical supralabial count as 7-7 and infralabials as 8-8, with the supralabials sometimes 6 on a side and infralabials sometimes 9 on a side; of the seven specimens he used for illustrating variation, he gave infralabials as 8-8 in three and 9-9 in four. Only one of the 25 I examined was other than 9-9, being 10-9. Obviously Ernst and Barbour (op. cit.) and P.W. Smith (op. cit.) have a different interpretation of where supralabials and infralabials end. To me, the last large scute on the upper margin of the opened mouth is the last supralabial, and any scutes on the lower jaw that abut on the last supralabial of the closed mouth are infralabials. This is apparently how H.M. Smith (op. cit.) and Hahn and Wilson (op. cit.) determined the count.

The contrasting scute counts described above remind us that standardization of methods is highly desirable and the techniques of counting and measuring should be clearly stated so that uniform comparison of values can be made.

Regarding the length of the newborn snakes, Ernst and Barbour (1989) stated that the young are 180-234 mm long (all reported lengths in Ernst and Barbour are total lengths—pers. comm. from Ernst). Larry David Wilson kindly provided the raw data for the Hahn and Wilson (1966); the data show that range of males was from 169-230 mm length, and females 195-236 mm total length. The 169 mm length is substantially less than Ernst and Barbour's 180 mm figure. But the litter that I examined ranged from 226-272 mm, with eight males exceeding those of Hahn and Wilson's collection and seven exceeded the largest previously reported specimen of either sex and among females all 12 exceeded those in Hahn and Wilson's collection, and were at least three mm longer than any previously reported specimen of either sex.

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A NEW CHROMOSPECIES OF SNAKE (*PSEUDOLEPTODEIRA*) FROM MEXICO

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Pseudoleptodeira uribei is described from Chamela, Jalisco, where it is sympatric with the only other known species of the genus, *P. latifasciata*. The two species are distinguishable solely in several features of pattern, so far as known; the most striking difference is that the latter has 7-10 large dark blotches on body, three on tail, whereas the former has 35-44 on body, 15-22 on tail. Although the two patterns may prove to be merely different chromotypes of one species, they are best regarded at present as diagnostic of different species, much like the partially sympatric species *Phyllorhynchus browni*, with few, large dark blotches, and *P. decurtatus*, with numerous, short blotches, that do not differ significantly otherwise.

Five specimens of *Pseudoleptodeira* taken in recent months near Chamela, Jalisco, Mexico, differ so strikingly in pattern from the only other species known of the genus (*P. latifasciata* (Günther)) that we here assign them to a new species,

Pseudoleptodeira uribei sp. n.

Holotype. An adult male, Instituto de Biología Herpetological Collection, Universidad Nacional Autónoma de México (IBHUNAM) 07528, from the Estación de Biología "Chamela" (EBCH, less than 5 km from the Pacific coast, at approximately 19°30'N, 105°03'W, el. 10-584 m), taken by Alicia Rodríguez Palafox Nov. 27, 1991. **Paratype.** An adult female, IBHUNAM 07529, from the same locality, taken by the first coauthor July 22, 1990.

Diagnosis-Definition. A member of the genus *Pseudoleptodeira* as defined by Dowling and Jenner (1987: 198), but differing from the only other contained species (*P. latifasciata*) in having (1) numerous dark blotches (35-44 on body, 15-22 on tail, vs. 7-10 and 3-4, respectively); (2) blotches ending on scale rows 2-3 (vs. ends of ventrals); (3) small lateral intercalary dark spots, extending onto ends of ventrals (vs. none); (4) light interspaces involving ~1 scale length (vs. 3-5); (5) ventral surfaces posterior to nape essentially immaculate, even on tail, except for narrowly encroaching intercalary spots (vs. sides of ventrals prominently smudged, subcaudal surfaces heavily pigmented); (6) anterior dark blotch on body much longer than others (2-3 times), covering 8-11 scale lengths near midline (vs. much

shorter than others, $1/3$ to $1/4$ their length, covering about 5 scale lengths at midline); and (7) perhaps nape color lighter, reddish yellow (vs. bright red or orange). Scutellation as in *P. latifasciata* so far as known, although number of ventrals and caudals may average different. Compare figs. 1-6 of *P. uribei* and Figs. 7-8 of *P. latifasciata*.

Description of holotype (Figs. 1-6). Head distinct from neck, length to rictus oris 14.3 mm, width at ricti oris 12.7 mm; snout truncate in dorsal view; eye relatively large, 3.0 mm in diameter, about one third length of snout (9.3 mm) to eye; pupil vertical; rostral about twice as broad (3.3 mm) as high (1.7 mm); internasals as broad as long, contacting nasal; prefrontals wider (2.7 mm) than long (2.1 mm), contacting nasal, loreal and upper preocular; frontal longer (4.4 mm) than broad (3.3 mm), 2.3 times as long as median prefrontal suture (1.9 mm); parietals longer (5.8 mm) than wide (4.0 mm), median suture (4.0 mm) slightly shorter than frontal.

Nostril in center of divided nasal; loreal as wide as high; preoculars 2-3, upper larger (2.2 mm high, 1.3 mm long), lower small, as high as long (0.6 mm); postoculars 2-2; supralabials 8-8, 1st and 2nd contacting nasal, 2nd and 3rd the loreal, 4th and 5th the eye, 6th and 7th the anterior temporal, 8th the lower secondary temporal; temporals 1-2.

Mental slightly broader than long, separated from chinshields by broad median contact of 1st infralabials; latter 9-10, 1-4 contacting anterior chinshields, 4-5 the posterior chinshields; latter larger (4.3 x 2.0 mm) than former (3.5 x 2.0).

Dorsal scale rows 21-23-17; two apical pits; ventrals 190; anal divided; subcaudals 83, divided.

Total length 481 mm; tail 111 mm, 23% of total length.

In life, dark markings dark chocolate brown, light areas cream; 44 dark blotches on body, extending laterally to 3rd scale row anteriorly, 2nd posteriorly, lateral ends usually rounded, midline length mostly 4-5 scale lengths, a few as short as 3 scale lengths, nape blotch longer; 22 similar blotches on tail; light interspaces 46 on body, 21 on tail, all covering ~ 1 scale length, about $1/4$ to $1/3$ length of adjacent dark blotches; a few interspaces staggered at midline, especially in neck region, producing a neck blotch 8 scales long on one side, 11 on the other. Small lateral intercalary blotches on lower 2-3 dorsal scale rows and ends of ventrals; otherwise ventral surfaces of body and tail immaculate.

Top of head and a dark streak on sides of head through eye to lower edge of nuchal blotch dark brown; enclosed light area on neck and in

temporal region reddish yellow, involving sides of parietals but leaving a short middorsal dark streak extending posteriorly two scale lengths behind median parietal suture; supralabials, infralabials, and lateral gulars dark-centered; a few anterior ventrals with a pair of small dim dark spots.

Variation. The paratype is essentially like the holotype, but is 428 mm in total length, tail 83 mm, 19.4% of total length; ventrals 191; subcaudals 64; dark blotches 35 on body, 15 on tail; light interspaces 37 on body, 15 on tail. A narrow dark streak traverses the middle of each light interspace (Fig. 6).

Three other specimens in the EBCH collection, all from the same area as the types, have been observed but were unavailable for critical study by the first coauthor.

Habits and habitats. All specimens have been taken in a lowland tropical deciduous "dry" forest with marked seasonality. Whether there is any habitat segregation of *P. uribei* from its sympatric congener (Casas, 1982; Ramírez et al., 1982) is unknown. Specimens were found at night on the ground between 2000 and 2100 h. The diet presumably consists of lizards such as *Hemidactylus frenatus* and *Phyllodactylus lanei*.

Etymology. The specific name is a patronym in the genitive case honoring Dr. Zeferino Uribe Peña, an eminent herpetologist on the faculty of the Universidad Nacional Autónoma de México.

Comparisons. The diagnosis summarizes the distinctions between the two species of *Pseudoeleutheria*; all pertain to pattern, except for the nape color, which may not prove to be valid. The other six differences, of pattern, are assumed to be constant inasmuch as five are known of *P. uribei*, all from the vicinity of EBCH, and perhaps as many as two or three dozen of *P. latifasciata*.

Known variation in color in life of the nuchal light area can be summarized as follows, in *P. latifasciata*. Taylor (1939: 343) records it as "brick red" in a specimen from El Sabino, Michoacán, "red-orange" in one from El Naranjo, Guerrero, and (Taylor, 1940) "red" in one from Huajintlán, Morelos; Duellman (1958: 93) records "brick-red" for one from La Salada, Colima and "orange-salmon" for another from La Unión, Guerrero; Fouquette and Rossman (1963: 195) "bright enamel red" for one from 6 mi SE Tehuiztzingo, Puebla; Davis and Dixon (1959: 84) "orange" for one from Acahuizotla, Guerrero; Boulenger (1905: 247) "bright red" for one from Río Balsas, Guerrero; and Casas (1982: 199) "rojo" for one from EBCH. These reports all indicate a more intensive color on the nape in *P. latifasciata* than the reddish yellow of our specimens of *P. uribei*. Further observations are

required to establish conclusively the validity of this distinction, which, if confirmed, would be useful in application only to live specimens, and perhaps only to adults.

Dowling and Jenner (1987: 193, 197) point out the importance of position of scale row reduction in characterization of genera related to *Leptodeira*, noting that *P. latifasciata* has midlateral reduction. The holotype of *P. uribei* has sublateral reduction, and thus that species may well differ consistently in that character from its congener, although the generic distinction from *Leptodeira* (with paravertebral reduction) still holds. Data on more specimens of *P. uribei* are necessary to evaluate the possible interspecific difference in this character.

Likewise inconclusive is the constancy of the difference in number of infralabials contacting the chinshields. Duellman (1958: 92) records infralabials 1-5 contacting the anterior, 5-6 the posterior chinshields, whereas those figures for the types of *P. uribei* are 1-4 and 4-5, respectively.

The hemipenis of *P. latifasciata* is described by Duellman (1958: 92), but the partially everted hemipenes of *P. uribei* (Fig. 9) suggest that interspecific differences may exist.

It is still possible that *P. uribei* may prove to differ from *P. latifasciata* significantly, if not categorically, in number of ventrals or caudals. The male holotype, with 190 ventrals and 83 caudals, slightly exceeds both maxima so far known for *P. latifasciata*: 186 and 82 respectively. The female paratype also has a high ventral count at 191, but a very low caudal count of 64 (vs. 176-192 and 64-71, resp.). Further data will be required to evaluate the significance of these apparent, minor differences.

The only name regarded as a synonym of *P. latifasciata* is *Leptodira guilleni* Boulenger (1905: 247, pl. 7, figs. 2A-B), from Río Balsas, Guerrero; his illustrations and description clearly pertain to *P. latifasciata*. Although the latter had already been described by his institutional colleague from material in the same museum, Boulenger presumably was misled by Günther's referral of his species to *Hypsigena*. Certainly *P. latifasciata* resembles members of *Leptodeira* much more closely than those of *Hypsigena*, as is evident in Duellman's referral (1958) of *P. latifasciata* to the genus *Leptodeira*.

Remarks. In spite of the several possible distinctions of the two species as here interpreted of *Pseudoleptodeira*, in morphology and nape color, the only certainties lie in pattern—a situation disquieting to the view of their status in reality as separate species. Inasmuch as both have been taken on the EBCH (Casas, 1982; Ramírez et al., 1982), they are clearly not

subspecifically related; they are either specifically distinct or are chromotype variants of one species (*P. latifasciata*). Numerous examples exist of striking sympatric chromotype variants in single species, e.g. *Chilomeniscus cinctus*, *Lampropeltis getula californiae*, *Loxocemus bicolor*, *Sonora semiannulata*, *Toluca lineata*, etc. However in each case the sympatric variants do contrast unicolor (or nearly so) or striped patterns with blotched ones, or hypermelanistic with normal coloration (*Loxocemus*); none involves sympatry of sharply disparate numbers of blotches.

In at least one case involving such sympatry without significant morphological differentiation, two different species are recognized, each even with several subspecies: *Phyllorhynchus browni*, with few, large blotches, and *P. decurtatus*, with numerous, smaller blotches. We regard *Pseudoleptodeira* as a close parallel of *Phyllorhynchus* taxonomically.

That the numerous blotches and other pattern peculiarities of *P. uribei* are not rare anomalies is apparent by the relatively numerous specimens known of it - more than the two *P. latifasciata* recorded from the same locality (Ramírez et al., 1982). The specimens reported since Duellman's monograph appeared (1958) alter nothing in his summary of variation in external structure or pattern (Davis and Dixon, 1959; Fouquette and Rossman, 1963; Shannon and Humphrey, 1964; Casas, 1982; Ramírez et al., 1982; Dowling and Jenner, 1987; Sánchez and López, 1988) except for the extension to 10 in the number of body blotches from 7-9 (Casas, 1982). The geographic range of *P. latifasciata* is now known to extend from 6 mi SE Tehuizingo, Puebla (Fouquette and Rossman, 1963), on the east to the EBCH in Jalisco on the west.

Since *P. uribei* occurs at the western limit of the range of *P. latifasciata*, the possibility is suggested that it may extend northward beyond the limits of *P. latifasciata*.

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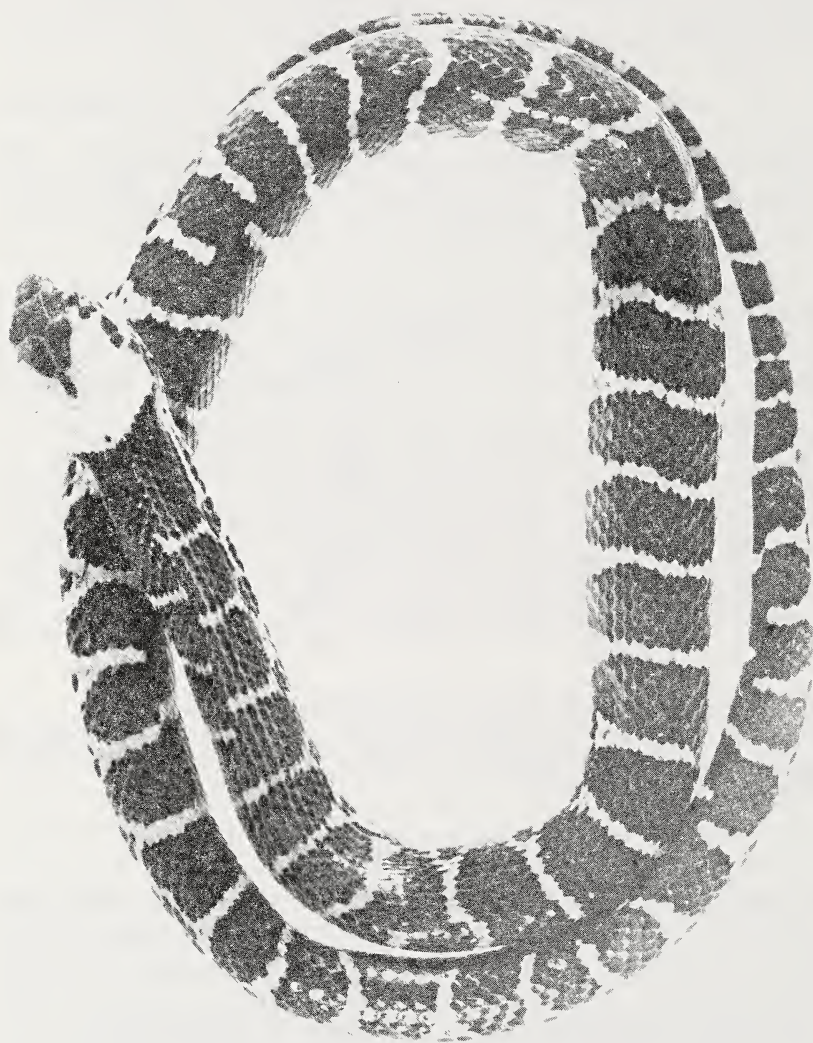


Fig. 1. Dorsal view of holotype of *Pseudoleptodeira uribei*.

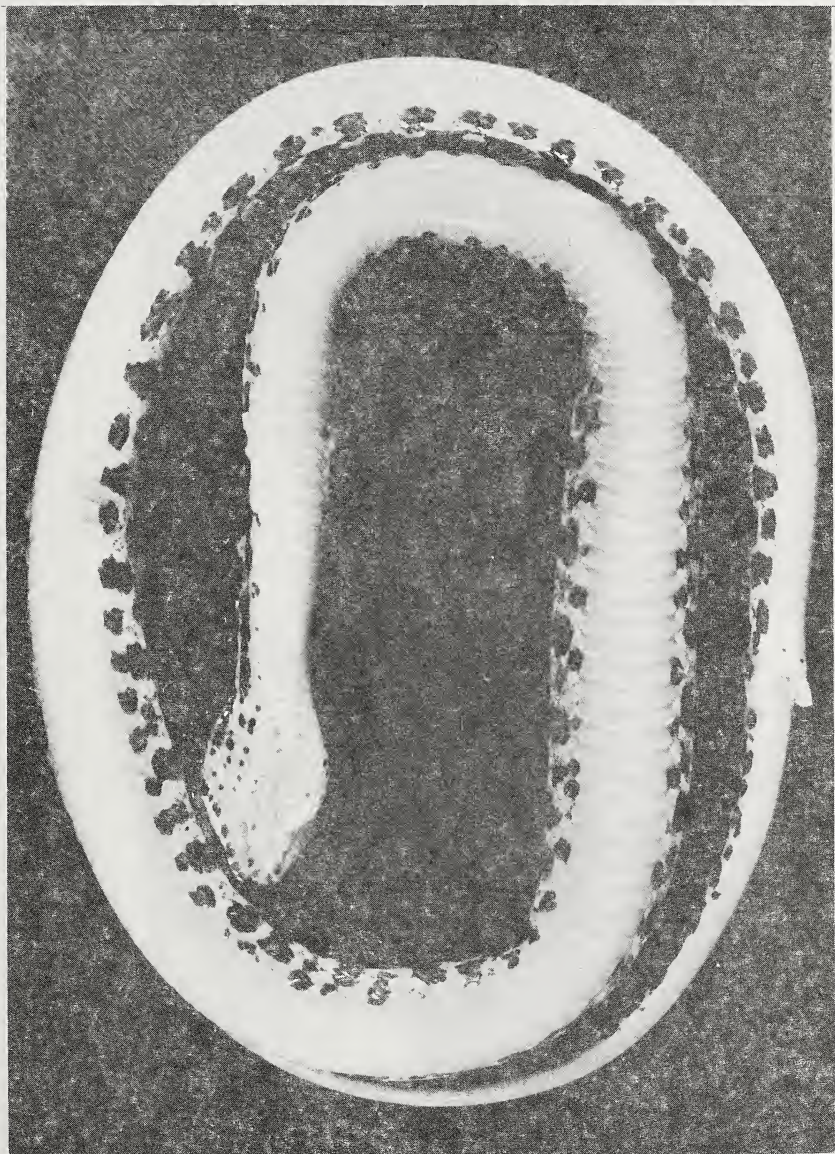


Fig. 2. Ventral view of holotype of *Pseudoleptodeira uribei*.



Fig. 3. Dorsal view of head and neck of holotype of *Pseudoleptodeira uribei*.



Fig. 4. Ventral view of head and neck of holotype of *Pseudoleptodeira uribei*.

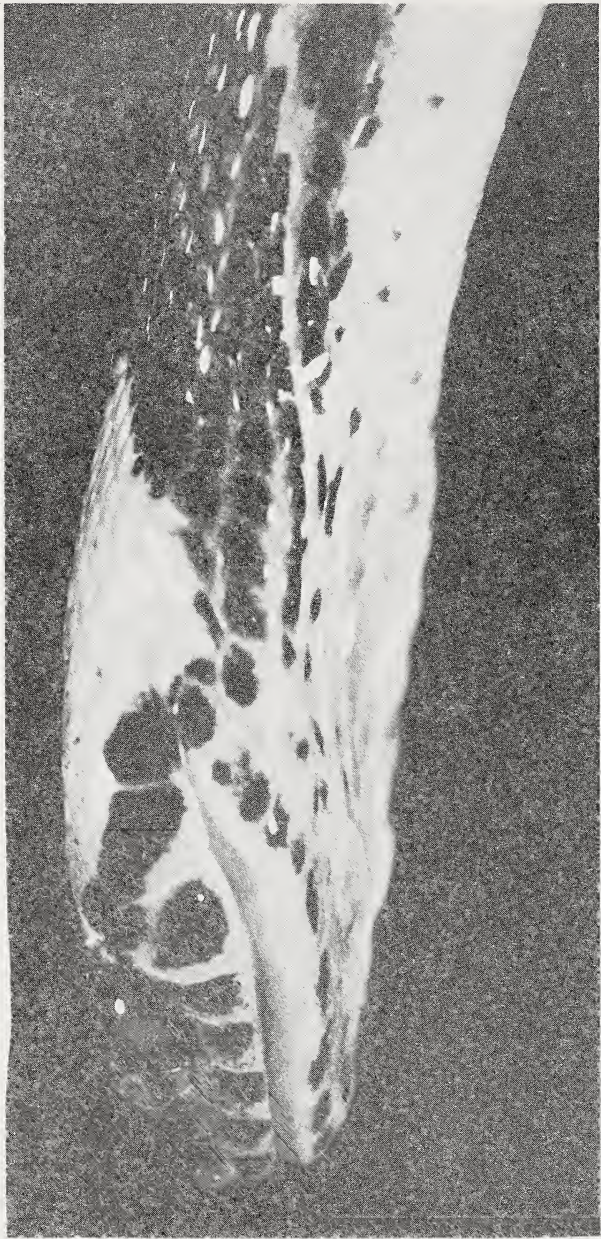


Fig. 5. Lateral view of head and neck of holotype of *Pseudoleptotetra uribet*.



Fig. 6. Dorsolateral view of the paratype of *Pseudoleptodeira uribei*.

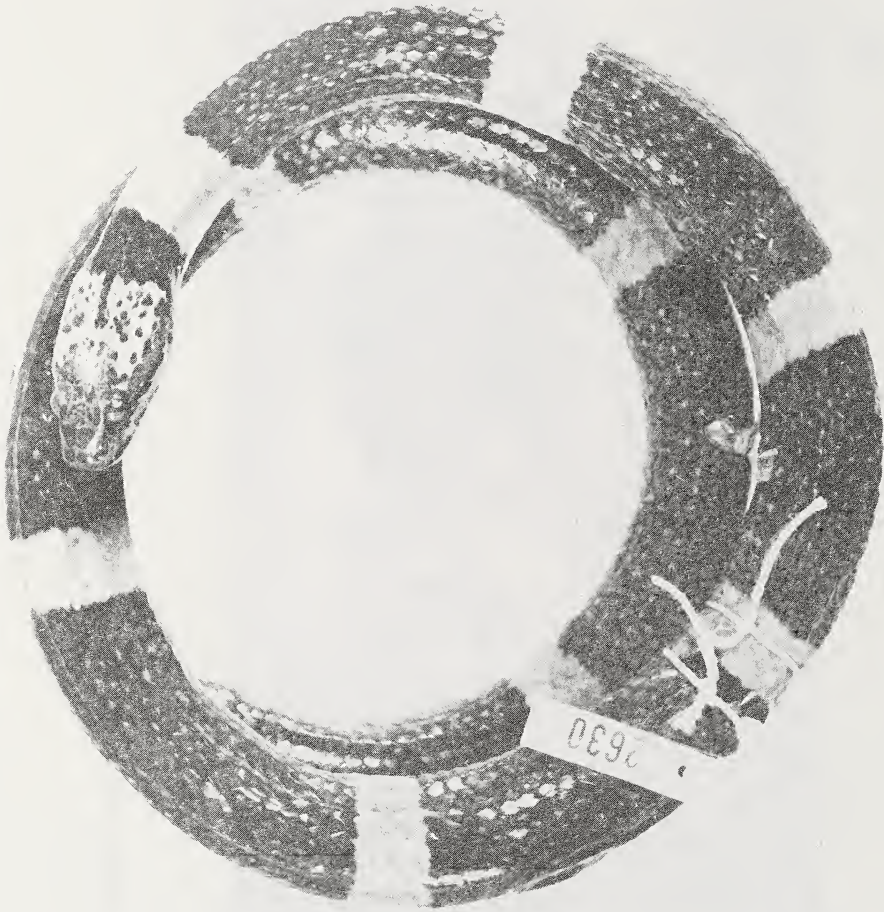


Fig 7. Dorsal view of *Pseudoleptodetra latifasciata*, IBHUNAM 2630 from Playa Careyes, 10 km SE Chamela, Jalisco, Mexico, 663 mm total length.

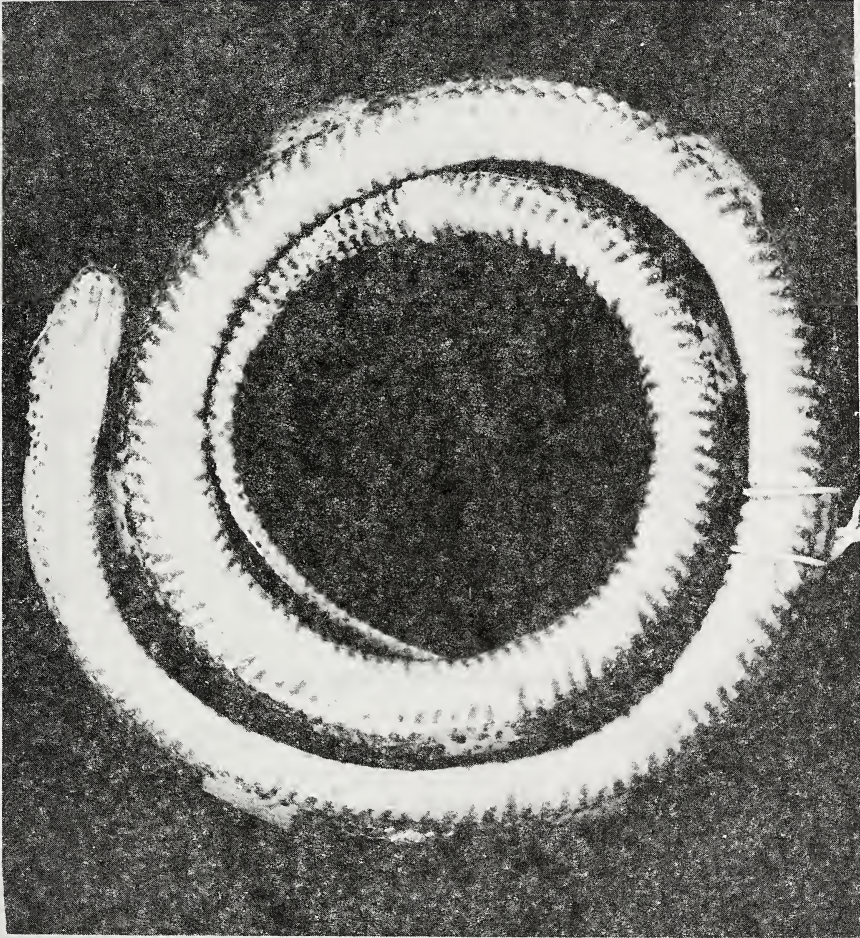


Fig. 8. Ventral view of *Pseudoleptodeira latifasciata*, same as in Fig. 7.

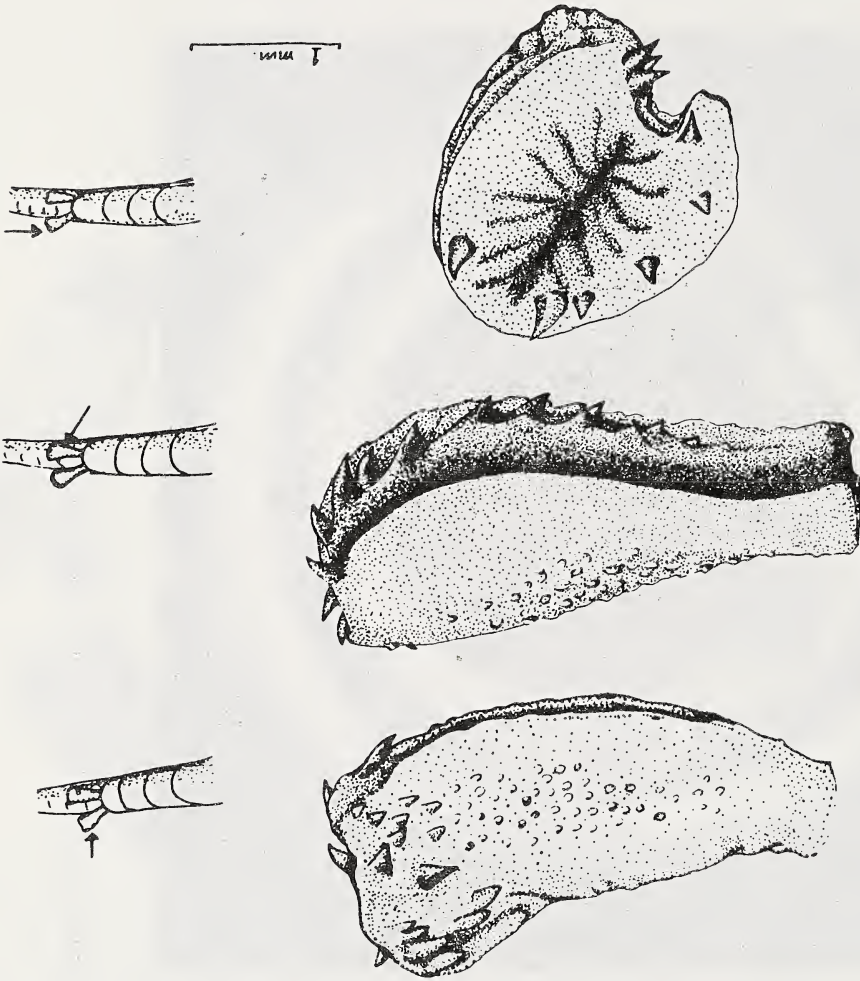


Fig. 9. The partially everted hemipenes of the holotype of *P. uribei*. Drawings by Zeferino Uribe.

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ADDITIONAL RAINBOW SNAKES, *FARANCIA ERYTROGRAMMA*, FROM CHARLES COUNTY, MARYLAND

The rarest of Maryland's 23 species of snakes, *Farancia erytrogramma*, the rainbow snake, reaches the northern limit of its range in Charles County (McCauley 1945; Neill 1964; Committee...1973; Mitchell 1982). This relatively large semiaquatic species of the southern coastal plain was first reported from the state by McCauley (1939) based on three individuals (none present in systematic collections) found on Stump Neck in 1937, and Cooper (1960) added a second locality from near Newburg for a specimen (NHSM 3012) collected in 1960. McCauley (1939, 1945) and Cooper (1960) provided detailed notes on their material and discussed this species' status locally. Beyond these authors' contributions and the accurate (Harris 1969, 1975; Committee...1973) and inaccurate Tobey (1985) mapping of the records, nothing of consequence has been reported about the rainbow snake in Maryland for over 30 years.

In June 1990 Zyla was presented with a collection of live snakes by V. Charles Atkocius, Jr. Included with this material was a frozen rainbow snake found dead by Atkocius on an access road 2.5 air km southwest of Newburg, Charles County, at about 3:00 PM in late April or early May 1988. The collection site lies off the north side of U.S. Route 301 in the immediate vicinity of the mouth of Clifton Creek, which in recent years has been modified into a recreational area. The specimen (TSU 6509) was thus taken only 1.7 air km west of Cooper's record and does not augment the known range of this species in Maryland.

The specimen, an adult female, was completely thawed prior to preservation and has a total length of 1150 mm, with an undamaged tail measuring 150 mm (tail as a percentage of total length 13.04), 167 ventrals, 38 subcaudals, and scale rows of 17 anteriorly, 19 at midbody, 17 posteriorly and 15 just anterior to the anus. Although freshly killed when found, six to eight hours elapsed before the snake was frozen. Due to spoilage the collector gutted the specimen from its throat to its anus, so we cannot comment on stomach contents or reproductive condition. He informed us, however, that nothing of interest was noted in either regard.

Of additional interest, there is another, previously unreported, rainbow snake (TSU 1966) said to be taken at or very near the original Newburg locality by the principal collector of Cooper's (1960) specimen. No details are available concerning this snake, a juvenile of ca. 220 mm total length, except that it is believed to have been collected roughly a year after the one taken in 1960 (J.F. Cover, Jr., pers. comm.). The specimen

eventually fell into the possession of Cover, who donated it to Towson State University in 1982. We find it inexplicable that 20 years passed before anyone was made aware of this snake's existence. While opinion varies among local herpetologists as to how much support the current specimen lends to these earlier Newburg records, its main significance lies in documenting the continued presence of *Farancia erythrogramma* in Maryland.

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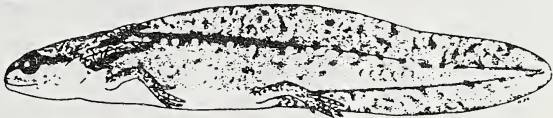
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NEW BOOKS:

New from the University of Georgia Press

GUIDE TO THE REPTILES
AND AMPHIBIANS OF THE
SAVANNAH RIVER SITE



J. Whitfield Gibbons and Raymond D. Semlitsch

Host to more than one hundred species of reptiles and amphibians, the Savannah River Site, a 780-square-kilometer tract in South Carolina, is one of the most intensely studied areas of herpetological ecology in the world. This guide is a summary of basic information on the site's richly varied herpetofauna, from their taxonomy and distribution to their behavior and habitats.

Keys to identify the adult and larval forms of the site's known species comprise the core of the guide. These keys are supplemented by maps, graphs, and illustrations as well as by information on habitats; population characteristics and distribution; behavior related to movement, feeding, and reproduction; morphology; and techniques for collecting specimens. The guide also includes information about special identification and study problems involving unresolved sighting reports; subspeciation; and venomous, edible, endangered, and introduced species.

Finally, a bibliography gives not only the sources referred to in the guide but virtually all studies and reports based on herpetological research conducted at the Savannah River Site. The site-related publications are listed by author but can also be found through an index to the subjects they cover.

Guide to the Reptiles and Amphibians of the Savannah River Site is a valuable one-volume introduction to the existing information on herpetofauna at the site and to the countless research opportunities the site still presents. Because it is clearly written and designed and lists most of the reptiles and amphibians found in Georgia and South Carolina, the guide is also useful to wildlife observers—professional and amateur—in those states.

J. WHITFIELD GIBBONS is a professor of zoology at the Savannah River Ecology Laboratory, Institute of Ecology, University of Georgia. He is author of *Their Blood Runs Cold: Adventures with Reptiles and Amphibians*. RAYMOND D. SEMLITSCH is an associate professor of biology at the University of Zurich.

Publication date: September 1991
4 maps, 26 illustrations
192 pages, 6 x 9 inches, \$20.00 cloth (unjacketed)



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Kate Slavens

At 506 pages, this edition is the largest and most current report on the status of living reptiles and amphibians in captivity. Information for 278 public and private collections found throughout the world. Includes a complete inventory listing providing location and sex of 46,865 specimens. Also included are longevity records, reproductive information for the previous season, and recent taxonomic name changes.

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INFORMATION REQUEST

Anyone keeping live reptiles and amphibians is asked to contribute to the annual inventory. Please submit the following information current January 1st of each year.

- (1) A complete inventory of all reptiles and amphibians living in your collection as of January 1. Sexes of adult animals should be included and listed male (1.0.0) female (0.1.0) unknown (0.0.1). Juvenile animals should also be listed using the same format. For example, 1.2.1 + juv 0.0.10 would read: 1 adult male, 2 adult females, 1 adult of unknown sex, 0 juvenile males, 0 juvenile females and 10 juveniles of unknown sex.
- (2) A list of all species bred during the previous year. Information may be sparse with simply an indication that the taxon was bred during the year, or it may be quite lengthy including, but not limited to: dates of copulation, dates of egg laying and hatching, types of substrates and temperature used during incubation, light cycles, hibernation, etc. Any type of valuable information up to three or four paragraphs may be used.
- (3) A list of all specimens in your collection which you believe may set longevity records for the species. List the date of acquisition; your specimen ID number; the sex; estimated age at capture; wild or captive bred; living or dead; there is also room for brief notes.
- (4) A list of any publications (including books, museum bulletins, journals, magazines, etc.) with reference to reproduction of captive reptiles and amphibians.
- (5) Please be sure to list your name, address and telephone numbers as you want them listed.

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P.O. Box 30744
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98103.

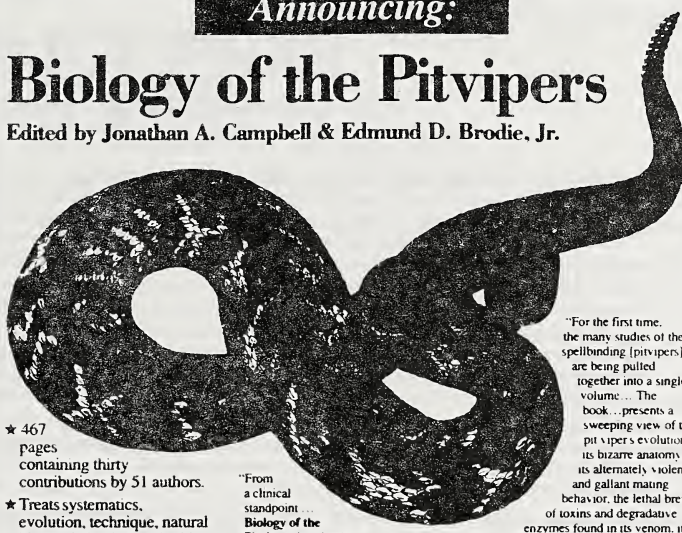


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Biology of the Pitvipers

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The University of New Mexico

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George Wan M.D.,
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The New York Times

"This volume is a good investment for serious students of viper evolution and ecology. The editors have brought together a number of timely, solid contributions that succeed admirably in providing both a good introduction, summaries of previous work, and new data and ideas. Recent years have brought us a number of other symposium volumes, but few have achieved this general level of scholarship."

Darrel R. Frost
Ass't. Curator of Herpetology,
American Museum of Natural History

The cover illustration of a Canebrake Rattlesnake, *Crotalus horridus*, by William B. Montgomery, was commissioned especially for **Biology of the Pitvipers**. It is a limited edition etching, hand printed on acid-free archival paper, signed and numbered by the artist. Each impression is individually hand colored by the artist using light-fast watercolors. The 16" x 22" prints will be sold at a special discount price of \$75.00 until August 15, 1992 (regular price \$100.00).

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NEWS & NOTES

*An Important New Book***HERPETOLOGY****CONTEMPORARY RESEARCH ON THE
BIOLOGY OF AMPHIBIANS AND REPTILES**

HERPETOLOGY is at once an old and yet also a newly revitalized field of research. It was founded in the 18th and 19th centuries on taxonomic, anatomical, and distributional studies, but during the last century, trends in biology and science fragmented the study of amphibians and reptiles into narrower and more disconnected disciplines. The recent renaissance of holistic approaches has helped to transcend these disciplinary boundaries, enabling herpetologists to become active participants and even leaders in this rebirth of the integrated study of animals, as the authors in this new volume demonstrate.

The "New Herpetology" was formalized in 1989 at the First World Congress of Herpetology, held in the United Kingdom, which brought together more than 1000 specialists on amphibians and reptiles from some 60 countries. Ecologists, anatomists, conservationists, geneticists, physiologists, paleontologists, and others who span the spectrum of biology met to share ideas and information. There was a general acknowledgment of the value of broadly integrated approaches to the study of a group of organisms, and the recognition that modern herpetology represents a vigorous and cohesive discipline of enduring significance.

The main feature of the Congress was a series of plenary lectures chosen to emphasize the range of current herpetological studies and to highlight those topics in which research on amphibians and reptiles have made major contributions to biology. This book contains the revised and updated versions of those lectures by authors who are among the world's leaders in their respective fields. Together, these essays demonstrate the breadth of modern herpetology and its continuing vitality as a discipline.

The volume also contains a detailed, illustrated summary of the meeting, with a list of all participants in symposia, workshops, roundtables, poster sessions, and other events. Included is a complete list of delegates and their addresses. This volume represents the summary of record for the First World Congress of Herpetology and a synopsis of current research in our discipline. It is an excellent introduction to modern herpetology for students and others interested in the biology of amphibians and reptiles.

Specifications: 225 pages, format 8 1/2 by 11 inches (22 by 28 cm), 20 photographs, numerous tables and graphs, clothbound in library-grade buckram. To be published December 1992.

TABLE OF CONTENTS

CARL GANS (USA): "The Status of Herpetology"

ILYA S. DAREVSKY (Russia): "Evolution and Ecology of Parthenogenesis in Reptiles"

LINDA MAXSON (USA): "Tempo and Pattern in Anuran Speciation and Phylogeny: An Albumin Perspective"

RUSSELL A. MITTERMEIER (USA) AND OTHERS: "Conservation of Amphibians and Reptiles"

TIM HALLIDAY (UK): "Sexual Selection in Amphibians and Reptiles: Theoretical Issues and New Directions"

ARMAND DE RICQLÈS (France): "Paleoherpetology"

S. DONALD BRADSHAW (Australia): "Ecophysiology of Desert Reptiles"

ERIC R. PIANKA (USA): "The State of the Art in Community Ecology"

DAVID B. WAKE (USA): "An Integrated Approach to Evolutionary Studies of Salamanders"

SUMMARY OF THE FIRST WORLD CONGRESS OF HERPETOLOGY

LIST OF CONGRESS DELEGATES WITH ADDRESSES

Prices and Ordering

The pre-publication price (before 15 November 1992) to SSAR members and to Delegates of the First Congress is \$20. The price to all other persons and to institutions is \$28. (Packing and shipping per volume: USA add \$2, other countries add \$4).

Numbers of copies ____ at \$____ per copy, plus \$____ total packing and shipping; total amount enclosed: \$____.

Send orders to: Dr. Robert D. Aldridge, SSAR Publications Secretary, Department of Biology, St. Louis University, St. Louis, Missouri 63103, USA. (Telephone 314-658-3916; fax 314-658-3117). Overseas customers must pay in USA funds using a draft drawn on American banks (include an additional amount to cover bank conversion charges) or by International Money Order. MasterCard or VISA are accepted (provide account number and expiration date); a 5% bank charge will be added to your account. A complete list of SSAR publications and applications for Society membership are available on request from Dr. Aldridge.

NEWS & NOTES



Second World Congress of Herpetology

29 December 1993 – 6 January 1994

For information please contact:
Michael J. Tyler, Department of Zoology,
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GPO Adelaide S.A. 5001, Australia.
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RELEASE FOR IMMEDIATE PUBLICATION

Upstate Herpetological Association is now accepting applications for a grant in the amount of \$400.00 to be awarded at our November meeting. Qualified applicants will submit a proposal detailing research or study of reptiles or amphibians on or before September 15th to Upstate Herpetological Society, HCR68 Box 30B Springfield Center, NY 13468. New or ongoing projects will be considered equally, however, preference may be given to those projects involving species native to New York.

Successful recipients will be required to submit a project summary for publication in the *Herp Beat* newsletter.

The International Herpetological Symposium, Inc.
Announces the 17th Annual Symposium
to be held in Miami Beach, Florida
June 17th through June 20th.

CALL FOR PAPERS

The IHS presents papers on herpetoculture, natural history, veterinary medicine and other topics related to herpetology. Individuals interested in presenting a paper at this meeting should write to Richard Ross, MD, Institute for Herpetological Research, PO Box 2227, Stanford, CA 94309.

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NEWS & NOTES

EXPEDITION TO TOBAGO, WEST INDIES

January 4 to January 16, 1993

HERPETOLOGY ENTOMOLOGY MARINE BIOLOGY BOTANY

This is part of an on-going survey of the flora and fauna of Tobago. This trip will emphasize photographing the Tobago reptiles, and collecting samples of a number of little-known plant and animal groups. Participants will be housed in a 10-bed, 4-bedroom beach house (2+2+2+4) which has an adequate kitchen (we share the task of cooking) and hot showers.

The cost, which is \$40 U.S. per day, includes all meals, housing, and shared rental cars (we usually rent three cars for a group of ten people). Scuba diving is available at additional cost. Group air fares may be available out of the Baltimore-Washington area.

For further information contact:

Jerry D. Hardy, Jr.
22 Wade Avenue
Baltimore, Md., 21228
Phone 301-747-7724

NEWS & NOTES

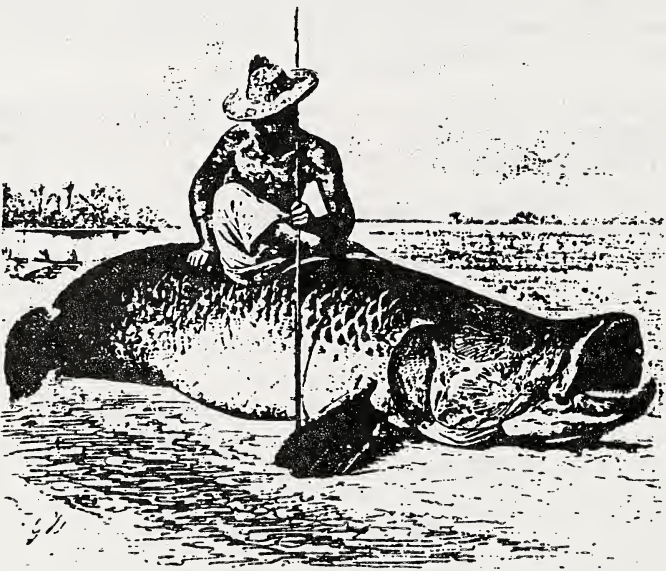
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THE EIGHTH ANNUAL MIDWESTERN HERPETOLOGICAL SYMPOSIUM



OCTOBER 16th - 18th, 1992

sponsored by the
*Wisconsin
Herpetological Society*
in celebration of their
20th Anniversary

SCHEDULE OF EVENTS

Friday, Oct. 16th

4:00 PM - 8:00 PM	Registration
5:30 PM - 7:00 PM	Set-up for Swap Meet
7:00 PM - 11:00 ?	SWAP MEET
7:00 PM - 11:00 ?	ICE BREAKER (in conjunction with Swap)

Saturday, Oct. 17th

8:00 AM - 8:30	Donuts, Coffee, Cool Pop
8:30 AM - Noon	Talks
1:00 PM - 5:30 PM	Talks
7:30 PM - 9:00 PM	Banquet - Milk Snake Slide Show with Author, Kenneth Williams
9:00 PM - 10:30	Auction

Sunday, Oct. 18th

8:00 AM - 11:00 AM	Talks
11:00 AM - 5:00 PM	Zoo Tour (own transport)

THE LINE-UP OF SPEAKERS

Dale Bertram - Topic: to be announced
Gary Casper - Update on Wisconsin's Herp Atlas Project
David Chiszar - "Strike Induced Chemosensory Searching
and Chemical Clues Used by Rattlesnakes During
Predatory Episodes"
Michael Goode - "Reproductive Patterns in Freshwater
Turtles"
Robert Hay - Ornate Box Turtles in their Natural Habitat and
in Captivity
Robert Henderson - "Distribution and Geographical
Variations in the Wide Spread Neo-tropical Tree
Boa *Corallus enydris*"
Tom R. Johnson - Illustrating the Peterson Field Guide
John Meltzer - "Captive Reproduction and Husbandry of the
Western Hognose Snake"
Michael Miller - "When to Take Your Herp to the Vet", and
File Snakes
Chris Palmer - Husbandry and Reproduction of Amphibians
David Sorensen - Husbandry and Reproduction of the
Rough-scale Sand Boa *Eryx conicus*
Peter Strimple - Asian Monitors
Thomas Tynning - "Uncommon Behavior of Common
Amphibians and Reptiles"
Kenneth Williams - "Honduran Cloud Forest Herpetology,"
and a special Slide Show presentation during the
Banquet on Milk Snakes

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When making reservations you must mention the Eighth
Midwest Herp Symposium sponsored by the Wisc. Herp
Soc. to receive reduced room rates. Also make sure to get
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REGISTRATION FOR SYMPOSIUM

Name _____

Address _____

Number

_____	Full Registration (Talks, Banquet)	\$52
_____	Late Registration (after Sept. 30)	\$67
_____	Talks only	\$35
_____	Talks only (late registration)	\$45
_____	Students under 16 (talks only)	\$20
_____	Banquet only	\$20
_____	Banquet only (late registration)	\$22

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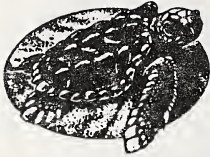
Send to: Wisconsin Herpetological Soc.
P.O. Box 366
Germantown, WI 53022

There'll be a swap meet for symposium attendees: Trophy
to the *Best of Show*. Tables will be available at the swap
meet for a donation to the Auction. Only captive bred
animals - no imports. For reservations call (414) 353-4375.

No venomous animals allowed in or near Hotel. The selling
of animals in hallways, parking lots, and other public areas
is not permitted.

Please bring your photographs of "People and Herps,"
preferably 8 x 10's, for our display board. Attendees will
vote on their favorite!

NEWS & NOTES



Sea Turtle Restoration Project

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CONTACT: Kathy Nielsen: 415-788-3666 or 800-859-SAVE (7283)

**EARTH ISLAND SPONSORS HANDS-ON EXPEDITIONS TO SAVE
THE GIANT SEA TURTLES**

**Volunteers to assist conservation projects
on Pacific coasts of Costa Rica and Nicaragua**

San Francisco, June 24, 1992 -- Earth Island Institute's Sea Turtle Restoration Project today announced its volunteer expeditions to three of the most important sea turtle nesting beaches for the endangered olive ridley as part of its continued worldwide efforts to protect and restore threatened sea turtle populations. The olive ridley is known for its massive "arribadas," the near simultaneous arrival of tens of thousands of nesting sea turtles. "Arribadas" have been described as the most spectacular event in the reptile world.

"Watching an ancient sea turtle drag herself out of the dark surf and lay her eggs as her kind has done for eons is an experience of a lifetime," said the Sea Turtle Restoration Project's Expedition Director Kathy Nielsen. "Seeing an 'arribada' is an incredible event experienced by very few people, something even most sea turtle biologists have not seen in person." These expeditions will travel to three of only twelve known beaches in the world where this fantastic phenomenon occurs.

Volunteers will team up with Latin and North American ecologists and marine scientists to assist in studies to unravel the mysterious life histories of these ancient animals and protect nesting sites. "We believe that a successful eco-tourism venture must meet the needs of the Earth and the local people," Nielsen commented. "Participants will be helping conservationists with work that is of critical importance for this species' survival."

Volunteers choose to work at one of three beaches: Playa Nancite, Costa Rica; Ostional, Costa Rica; or Playa La Flor, Nicaragua. All three beaches are surrounded by beautiful tropical marine and forest habitats offering incredible wildlife viewing opportunities of such exotic animals as crocodiles, dolphins, coatis, howler monkeys, parrots, and iguanas. In addition to the olive ridley, three other species of sea turtles nest on these beaches including the leatherback. Leatherbacks can grow to be over nine feet long and weigh more than 2,000 pounds.

The Expeditions range in cost from \$500 to \$1250, averaging \$1000, not including airfare. Because participants will actually be working as volunteers for the non-profit environmental organization, Earth Island Institute, most or all of the costs, including airfare, are tax-deductible. The trip lengths vary from 7 to 14 days, with most trips being 10 days long. Volunteers need no experience, but must be in good physical condition.

People interested in the Sea Turtle Restoration Project Volunteer Expeditions should call 800-859-SAVE or 415-788-3666, or write to Sea Turtle Restoration Project, Earth Island Institute, 300 Broadway, Suite 28, San Francisco, CA 94133 for more information.

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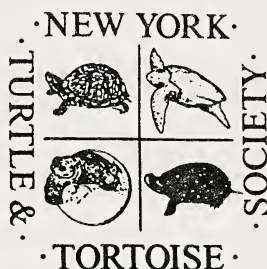
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INTERNATIONAL CONFERENCE ON TORTOISE & TURTLE CONSERVATION
TO BE HELD IN JULY 1993

Purchase, New York Event to be Sponsored by
the American Museum of Natural History's Turtle Recovery Program
and the New York Turtle & Tortoise Society

New York, NY, July 21, 1992 -- The American Museum of Natural History's Turtle Recovery Program and the New York Turtle & Tortoise Society announced today that they will co-sponsor Conservation, Restoration, and Management of Tortoises and Turtles -- an International Conference. The conference will be hosted by the State University of New York, SUNY Purchase and held July 11-17, 1993. The SUNY Campus is located in Westchester County, just 30 minutes north of New York City. The conference was made possible by a grant from the Bureau of Land Management (U.S. Department of the Interior).

The conference will provide a forum for a wide array of people concerned with conservation to critically assess current efforts and develop strategies for the future. Using turtles as a model, the conference will develop techniques that can be applied to the conservation of a wide array of flora & fauna. This "diversity of opinions" is necessary for the success of the conference because, according to Dr. Michael Klemens, the Turtle Recovery Program Director, and the originator of the conference's theme, "conservation today is a dynamic, multi-disciplinary field encompassing a variety of areas including science, economics, public policy, sociology, even philosophy."

Conference participants will include representatives from the academic, business, government, and private sectors including scientists, students, conservationists, wildlife managers, economists, land-use planners, government officials and policy makers.

-over-

*Dedicated to the Appreciation of Turtles and Tortoises—to their Conservation and Preservation of their Habitat,
to the Promotion of Proper Husbandry and Captive Propagation, and to the Education of the Public*

NEWS & NOTES

PAGE 2

Suzanne Dohm, President of the New York Turtle & Tortoise Society, predicts that "we'll have representation from six continents."

The Turtle Recovery Program is a joint initiative of the American Museum of Natural History and the IUCN-World Conservation Union Species Survival Commission. The program designs and implements turtle conservation programs around the world. The New York Turtle & Tortoise Society, one of the world's largest turtle groups, is dedicated to the conservation and preservation of turtles and tortoises and their habitat. The society is also committed to the promotion of the proper husbandry and captive propagation of turtles and tortoises.

Conference proceedings will be published.

For further information on the conference write to Craig Vitamenti c/o The New York Turtle & Tortoise Society, 163 Amsterdam Avenue, Suite 365, New York, NY 10023. Or call (212) 459-4803.

#

NEWS & NOTES

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The Herpetology On-Line Network is an open access computer bulletin board serving the national herpetological community. It contains areas where one can ask questions, exchange information, and discuss reptiles. There are many text files that can be downloaded to your computer, as well as a database of all national and local herp organizations in the U.S.



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USA

NEWS & NOTES

Society for the Study of Amphibians and Reptiles

Prepublication Announcement

Herpetological Circular No. 20

AGE DETERMINATION IN TURTLES

by

George R. Zug

A complete and detailed look at techniques used to determine the age of turtles, as well as a comparison of their effectiveness. The first section deals with known-aged samples via mark-release-recapture, and captive rearing; the second section looks at measures of size as a substitute for age, using body length or mass, and lens mass; a third area of this booklet addresses incremental growth markers for age determination with respect to scute growth zones, claws and rhamphothecae, and skeletochronology; and a fourth part covers age estimation through structural modifications as revealed by scute polishing, skeletal changes, and coloration changes. Bibliography. 1991. 28 pages. ISBN 0-916984-24-9

Prepublication price \$4.⁰⁰

After October 15, 1991 \$5.⁰⁰

*Orders may be sent to the Society Treasurer, Dr. Douglas H. Taylor
Department of Zoology,
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NEWS & NOTES

CHS Herpetological Grants A New Program to Support Herpetological Research, Education, and Conservation

The Chicago Herpetological Society is proud to announce the establishment of a program to award financial support for herpetological research, education, and conservation. *CHS Herpetological Grants* compliments the SSAR Grants in Herpetology program to provide more funds for herpetological research. Interested parties may apply for a grant in any one of the following categories, but may submit only one application per category per year. Not all categories may receive awards each year. Individual awards will not exceed \$500.

- 1) Herpetology in Illinois. Proposals may address any aspect of herpetology in Illinois.
- 2) Graduate Student Research in Herpetology
- 3) Undergraduate Student Research in Herpetology. Undergraduate and high school student research projects in herpetology for course credit, extra credit, science fairs, and the like should be submitted in this category.
- 4) Field Studies in Herpetology. Proposals involving travel expenses, survey collections and other fieldwork should be submitted here.
- 5) Conservation. Proposals involving threatened herpetological species or environments, declining populations, and similar problems are appropriate here.
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Applications will be similar to those for SSAR grants. Each must include:

- 1) Background and objectives of the proposal.
- 2) Materials and methods for carrying out the project.
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- 5) A letter of support from the most appropriate sponsoring party, such as faculty advisor or committee chairperson, course instructor, or the president of a sponsoring herpetological society.

The application must be typed, double spaced, and must not exceed 5 pages, excluding resume and budget. Failure to follow this format may result in an application being rejected. All applications must be submitted in duplicate and be received no later than 31 August 1991. Awards will be announced by 30 November 1991.

Submit applications or questions to:

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Society Publication

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The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at \$.25/page.

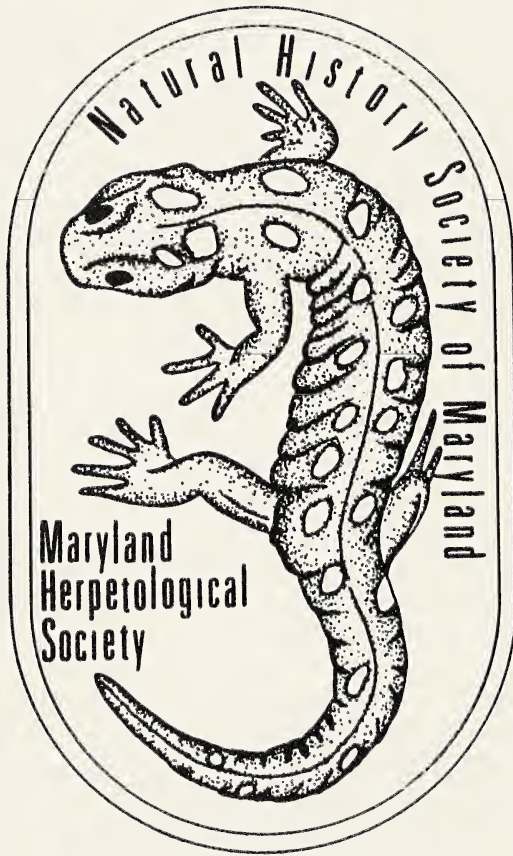
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All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

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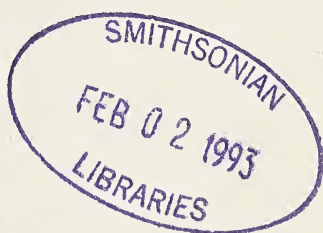
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Maryland Herpetological Society

DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.



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The Maryland Herpetological Society
Department of Herpetology
Natural History Society of Maryland, Inc.
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Volume 28 Number 4

December 1992

The Maryland Herpetological Society
Department of Herpetology, Natural History Society of Maryland, Inc.

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Meetings

The third Wednesday of each month, 8:15 p.m. at the Natural History Society of Maryland (except May—August, third Saturday of each month, 8:00 a.m.). The Department of Herpetology meets informally on all other Wednesday evenings at the NHSM at 8:00 p.m.

ADAPTIVE CONVERGENCE IN THE LIZARD SUPERSPECIES *SCELOPORUS UNDULATUS*

Hobart M. Smith, Edwin L. Bell, John S. Applegarth, and David Chiszar

Sceloporus undulatus tedbrowni subsp. nov. is described from the Mescalero Sand Dunes of southeastern New Mexico. The nine subspecies of that species are arranged in three exerges (subspecies groups). The six subspecies of *Sceloporus occidentalis* are arranged in two exerges. Their adaptive trends, lability and possible relationships are noted, in conjunction with the other species of the *undulatus* group.

Over twenty years ago, one of us (JSA) observed that a distinct subspecies of *Sceloporus undulatus* occurs sympatrically with an arenicolous member of the *S. graciosus* group in the Mescalero Sand Dunes of eastern Chaves Co., southeastern New Mexico. Indeed, representatives of the two species in that area are virtually indistinguishable in pattern and color (Fig. 3), and have few objectively distinguishable differences in scutellation. So similar are they that one *S. undulatus* (UNM 14825; acronyms from Leviton et al., 1985) was included among the topoparatypes of *S. g. arenicolous* (Degenhardt and Jones, 1972: 214). The latter taxon differs subjectively in being somewhat larger, far more wary, more restricted in habitat (limited to the dunes themselves, not partial to posts, debris, etc.), and it differs objectively in having more than 12 (usually about 15) scales between the medial ends of the femoral pores series (interfemoral count) (Fig. 2), whereas *S. undulatus* (Fig. 1) has no more than 8 (11 maximum in the entire species), fide Smith (1938: table 2).

We here name the sympatric race of *S. undulatus* and discuss its significance in adaptive radiation of the species.

Before doing so it is necessary to note that its similar-appearing congener is best regarded as a full species, even though some overlap in modally differing scale characters does occur (Degenhardt and Jones, 1972: 216) with *S. g. graciosus*, and their karyotypes are indistinguishable (Cole, 1975). Their color patterns do differ categorically, however, the Mescalero and allied populations (southward to the Monahans Dunes of Ward Co., Texas; Axtell, 1988) being uniformly light, virtually patternless; they are also widely dichopatric as well as distinctive in their extreme arenicolous habitat and habits. They are on an evolutionary tangent irrevocably separate from

their parent taxon, and, in that context, along with the completely unique features that they do have they merit recognition at specific rank; their lineage constitutes a distinctive phylogenetic trajectory, firmly established (Frost and Hillis, 1990:92).

A second, trivial but necessary change is in spelling of the species-group name originally proposed (Degenhardt and Jones, 1972: 213) as "*arenicolous*". That spelling is the anglicized version, as rendered in dictionaries of the English language, whereas scientific names in zoology have always been preferably of Latin or Greek origin, and, if a Latin adjective (as this name is), it "must be written with the Latin termination appropriate to the gender of its generic name" [International Code of Zoological Nomenclature, hereinafter referred to as "Code", 1985, Art. 31 (b), (c)]; an incorrect termination is to be corrected, although the original author and date remain unchanged [Art. 34 (b)]. Since *Sceloporus* is masculine, and the grammatical stem of the Latin *colus* is *col-*, the correct masculine ending is *-us*. Hence the proper spelling for the specific name of this taxon is *S. arenicolus*. Both Cole (1975: 289, footnote), and Collins (1990: 23; 1991: 43) retained the original spelling, although Cole noted that it "was not properly latinized." He applied Art. 32 of the Code in retaining the name, but in error, because that Article does not protect "incorrect original spellings" that contravene Art. 31. The correct spelling *arenicolus* was used as early as 1976 (Smith and Smith, 1976: L-B-129), although without explanation and in the combination *S. graciosus arenicolus*.

We here name the subspecies of *S. undulatus* occurring in the Mescalero and other transcaprock sand dunes

Sceloporus undulatus tedbrowni ssp. nov.

Holotype: UNM 33859, ad. male, Chaves Co., New Mexico, 6 mi W Caprock, Lea Co., large dune, Waldrop Peak, 0.5 mi S Hy 380, June 19, 1978; A. and H. Sena, colls. *Paratypes*: nineteen, including UNM 33823, topotype: UNM 33888, Chaves Co., 9 mi W Caprock, Lea Co., on fence on S side Hy 380; UNM 37105-08, Chaves Co., 7.5 mi W Lea Co. Line, 0.8 mi S Hy 380; UNM 14825, 27.5 mi E Bitter Lake State park turnoff from Hy 380, Mescalero Dunes; UNM 14144, Andrews Co., Texas; UNM 52061-52062, 52064-52065, Chaves Co., New Mexico, Mescalero Sands, along US Hwy. 380, ca. 38-40 mi E Roswell (T10S-R31E-S6); UNM 52063, Chaves Co., New Mexico, Mescalero Sands, along US Hwy 380, ca. 38-40 mi E Roswell, (T10S-R30E-S8), C. Painter and A. Landwer, colls.; AMNH 110029 and UCM 56276-7, Mescalero Dunes, Chaves Co.; UTEP 11077-79, two males, one female, Chaves Co., New Mexico, ca 18 air km WNW Caprock, or 5.4 road mi (US Hy 380) E Oasis and 0.4 road mi N on dirt road (T10S, R30E, SE 1/4 Sec. 20

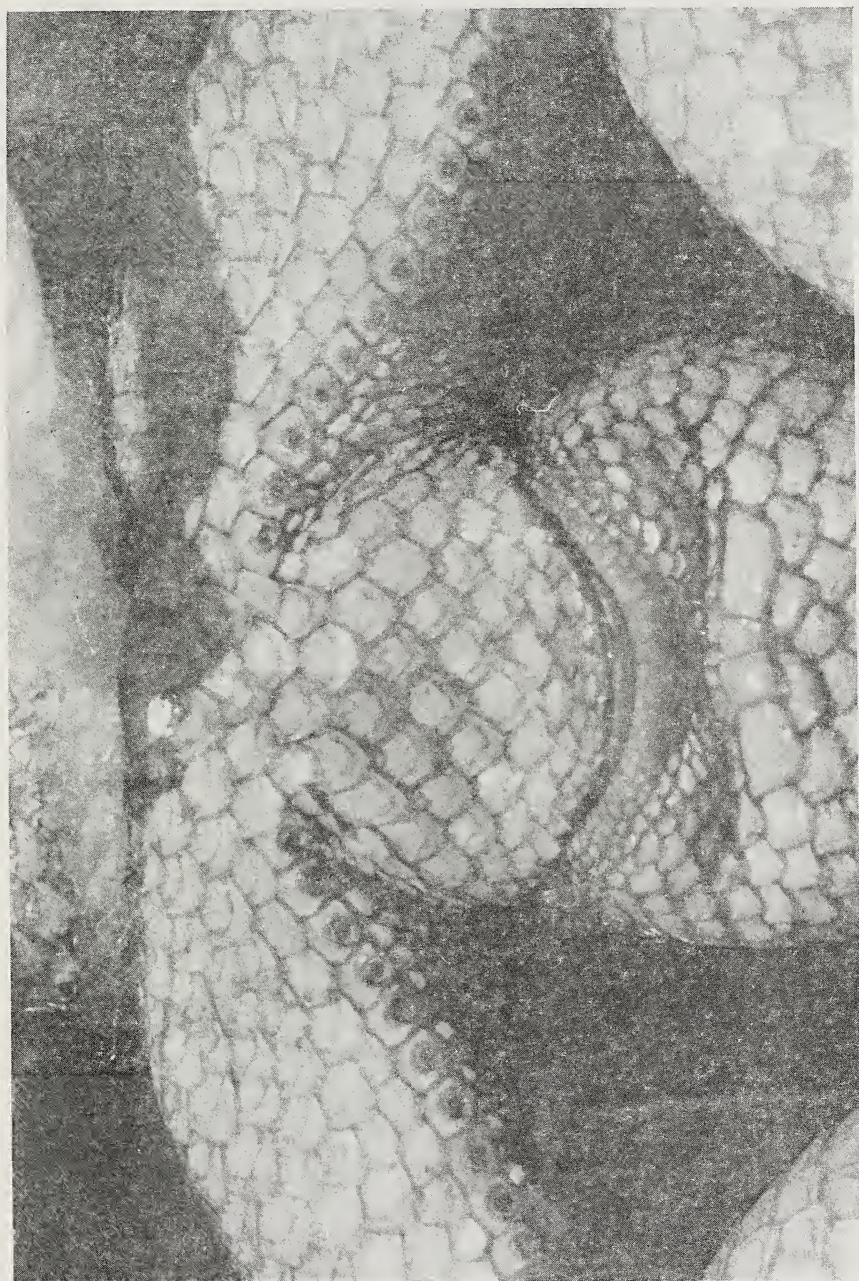


Fig. 1. Preanal region of *S. u. tedbrowni*, UNM 33888, male, 9 mi W Caprock, Lea Co., New Mexico, near Waldrop Peak, a large dune in the Mesalero Sand Dunes, Chaves Co. Note that 5 intersegmental scales lie in between the medial ends of the two femoral pore series.

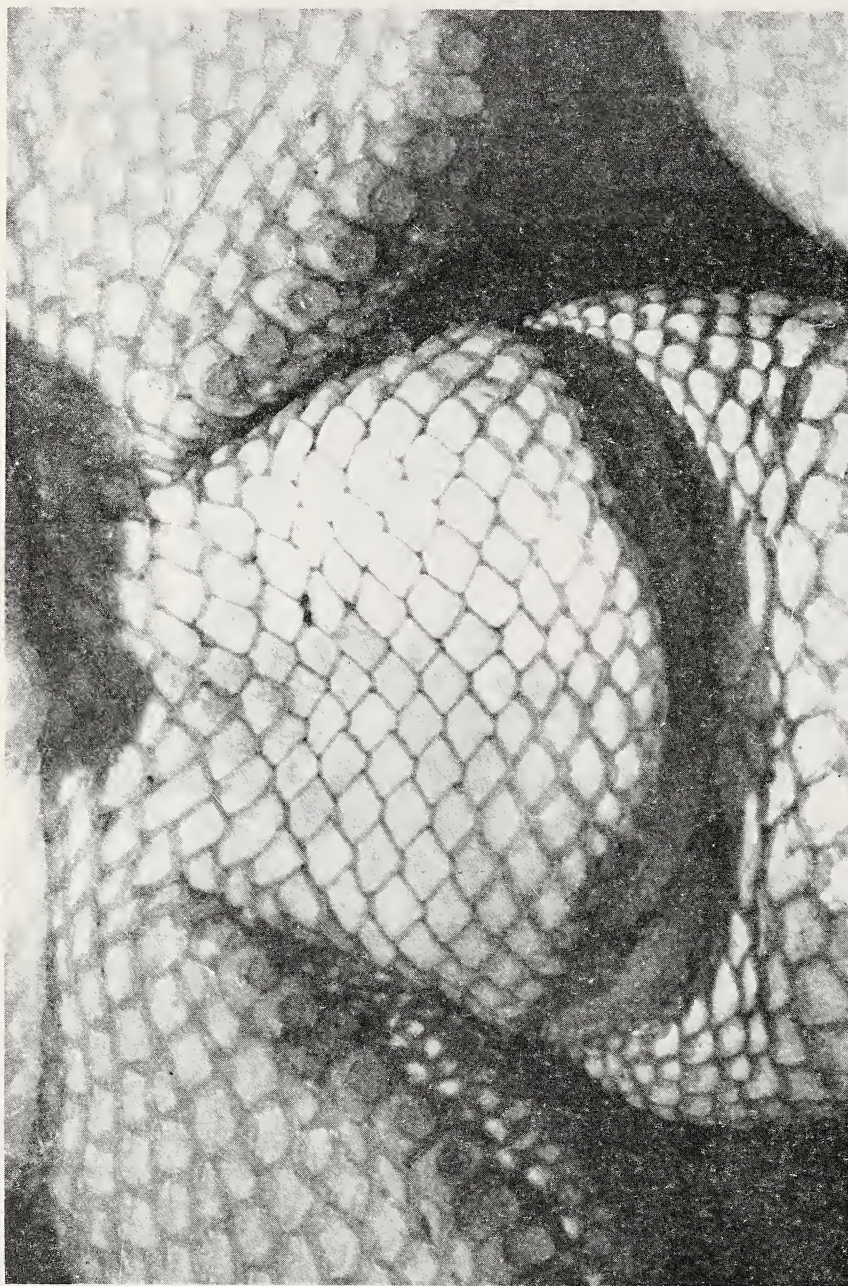


Fig. 2. Preanal region of *S. arenicolus*, UNM 33822, male, 10.5 ml S, 9 ml W Caprock, Lea Co., New Mexico, in Mescalero Sand Dunes, Chaves Co. Note that at least 14 scales are visible between the medial ends of the two femoral pore series; actually there are more, because the granular postfemoral scales intrude slightly between the interfemorals and femoral pore series. Note also that all preanal scales are proportionally much smaller than in *S. undulatus* (about half the size) (Fig. 1).

and NE 1/4 Sec. 29, C. S. Lieb, R. G. Webb, J. D. Johnson, and D. A. Kizirian, colls.

Diagnosis. A member of the terrestrial subspecies group of *Sceloporus undulatus*, with basically a light-striped pattern, not barred; dorsal surface typically very light, almost white, markings not or dimly evident; s-v length not exceeding 59 mm; no or vestigial gular semeions in both sexes, abdominal semeions only in males, narrowly confined laterally; femoral pores 13-17, mean 14.7; dorsals 38-44, mean 41.3; scales around body 40-47, mean 42.5; interfemoral scales (scales between pores series) 4-6, mean 4.6.

Description of holotype. An adult male, 50 mm s-v (Figs. 4, 5); tail 78 mm; head scales normal for the species; 4 postrostrals, lateral one contacting subnasal; internasals irregular; lateral frontonasals split but all 3 in contact; prefrontals separated by an azygous scale, left one split; frontal divided into anterior and posterior halves; frontoparietals single, separated by a median scale; parietal damaged on one side; interparietal much the largest scale on head or body, as long as frontal, as wide as long. Five superciliaries; 5 straplike enlarged supraoculars separated from all median head scales by a single complete row of oculofrontoparietals, and from superciliaries by 2-3 rows of small scales. Canthals 2-2; 1 subnasal; loreals 1-2; preocular divided horizontally; subocular 2/3 length of orbit, followed by 2 keeled postoculars; 2 rows of lorilabials complete below orbit; 4 supralabials and 6 infralabials to mid-eye. Six postmentals on each side, anterior ones in contact medially, 2nd pair separated by two granules; lateral labiomentals narrowly separated from mental. Three large auricular lobules, upper 2 extending across meatus; a deep lateral nuchal pocket. Dorsals 41; scales around body 46; 16-16 femoral pores; 4 interfemoral scales. Tip of foreleg 20 mm from axilla; tip of hind leg 31 mm from base of tail.

General tone pale gray; a broad (most of 2 scalerows) dorsolateral light line bordered laterally by a dark line of equal width; rest of sides whitish; middorsal area between dorsolateral light lines bluish gray, with a series of 7 small, dim, tan spots, each covering about 4 scales, along each side of trunk, against dorsolateral light line; no markings on limbs. Venter white except for a very narrow, diagonal gular semeion on each side, and a narrow, bluish, narrowly black-bordered (medially) abdominal semeion, not quite reaching level of axilla or groin, the two separated anteriorly by 10, posteriorly by 12 scale rows; 4 to 6 rows of whitish scales on each side between semeion and lateral dark line; no lateral light line.

Variation (Figs. 3-5). Two adult females (UCM 56276-7; Fig. 3)

captured alive by two of us (DC, HMS) in summer, 1990, retain their original color and pattern; they measure 49 and 53 mm s-v. Both are almost unicolor, as in life, a very light tan above, uniformly white below, without evidence of semeions; the dorsolateral light lines are evident, but not sharply defined, in both; lateral light lines are barely evident; paravertebral dark bars are faintly evident in one, but not the other. Five other adult females are available: UNM 14825, 50 mm s-v, a paratype of *S. arenicolus*; UNM 52065, 59 mm s-v; UNM 52061, 58 mm s-v; UNM 52064, 51 mm s-v; and UTEP 11079, 49 mm s-v; all appear much the same as the UCM specimens.

Four adult paratype males are available (UNM 33888, 52063; UTEP 11077-8) for comparison. They vary from 44-54 mm s-v and their dorsal coloration is virtually the same as in the holotype. UTEP 11077 and UNM 52063 have small, widely separated vestigial gular semeions; UTEP 11078 and UNM 33888 have no gular semeions. UNM 52063 has only one blue gular scale on the left and none on the right. Both semeions in UNM 52063 consist mainly of very small black dots placed far laterally. The abdominal semeions of these four males are separated by seven to nine scalerows, are a maximum of four scalerows wide, dark blue, with scattered black pigment along their medial borders, barely reach the axilla and groin, with no black extending onto the thighs. A very young male (UNM 33823, 31 mm s-v) taken at the same locality as the holotype lacks all evidence of semeions, and has little pattern.

A series of 4, taken Sept. 23, 1979 (UNM 37105-8) includes three juveniles and one adult; the juveniles (25.5 mm - 36 mm s-v) are all very dimly patterned, or patternless; the smallest is a hatchling. Inexplicably, however, the one adult (UNM 37107) is a brown female (Figs. 4-5), not faded or whitish as are all other specimens; its markings consist of a distinct dorsolateral light line on each side, a very dim lateral light line, and a series of 8 narrow dark bars on the medial side of each dorsolateral light line, leaving about 4 vertebral scale rows unmarked, uniform gray-brown.

The only specimen from outside the Mescalero Sand dune area referred to *S. u. tedbrowni* (UNM 14144) is a juvenile male (39 mm s-v), from Andrews Co., Texas, with no pattern except for dorsolateral light lines and faint evidence of a lateral light line, all on a light brown background. Verification of occurrence of the subspecies there requires more and better material, but Axtell's records of *S. arenicolus* (1988: 3, map 3) from six localities in that county suggest that *S. u. tedbrowni* accompanies it there.

Table 1 summarizes the basic data on the type series. No variations in head scales appear to be significant in comparison with other races of the species.

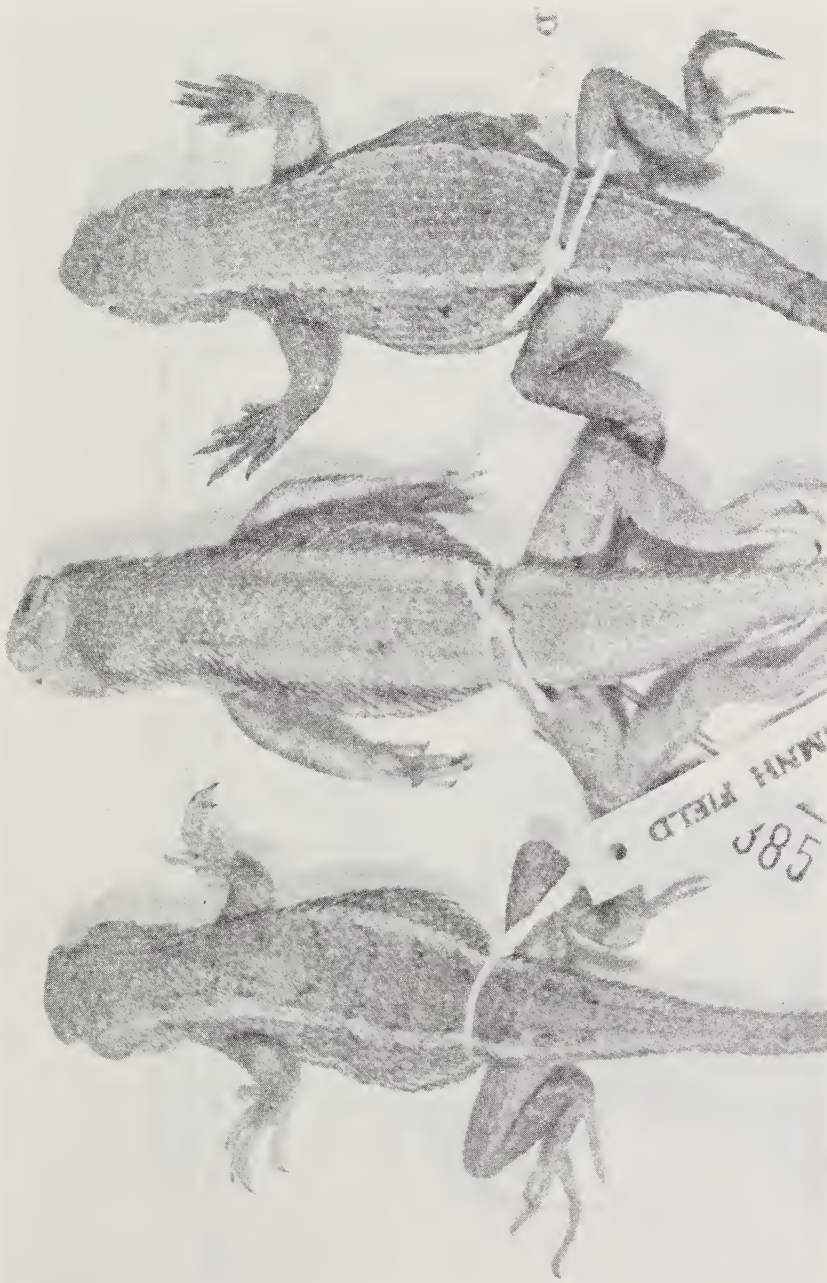


Fig. 3. Comparison of dorsal pattern of female *S. arenicolus* (center) and *S. u. tedbrowni* (right, left). Specimen on right, 53 mm s-v. Left and right UCM 56277, 56276, respectively, road to campground off Hy 380, Mescalero Dunes, Chaves Co., New Mexico; center, UNM 33885, Mescalero Dunes, Chaves Co., N. M., 6 mi W of Caprock, Lea Co., 2 mi N Hy 380.

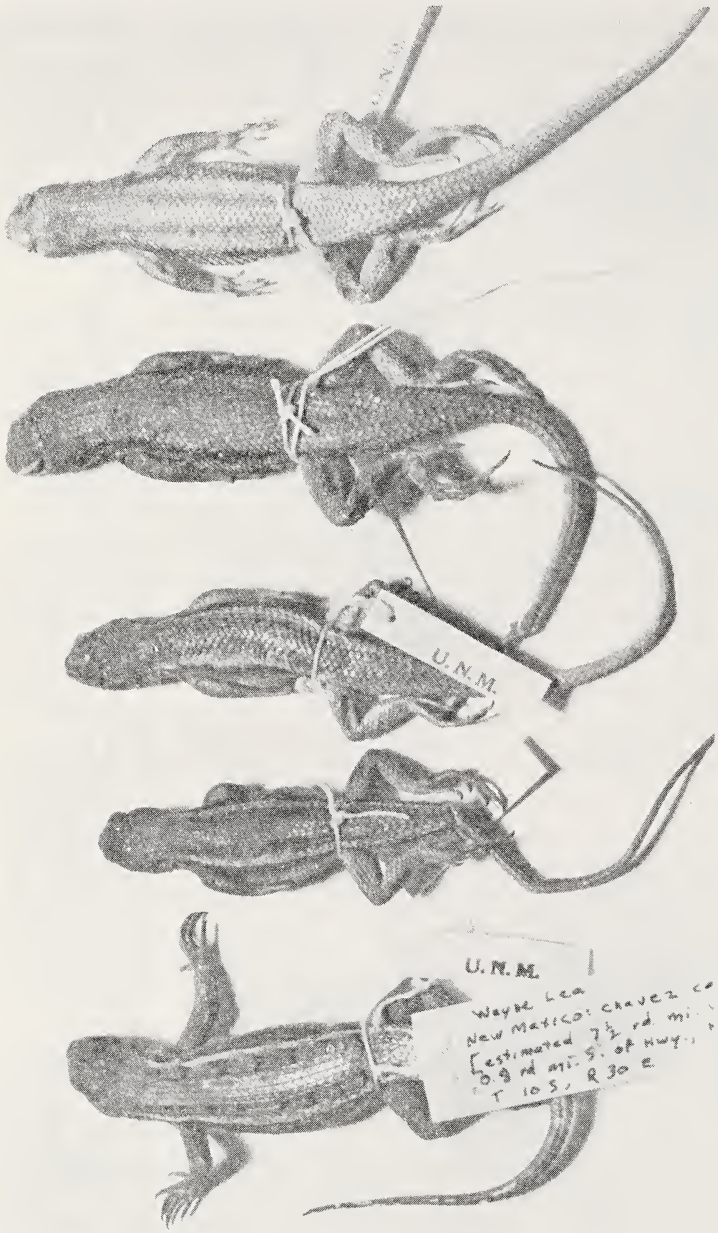


Fig. 4. *S. u. tedbrowni* (left three) and *S. arenicolus* (right two) compared in dorsal view, all UNM specimens. Left to right, 37107, female paratype; 33888, male paratype; 33859, male holotype; 33822, male paratype, see Fig. 2 for data; 33885, female paratype, see Fig. 3 for data.



Fig. 5. Same as Fig. 4, ventral view.

Etymology. The subspecies is named for Ted L. Brown, a long-time authority and leader in the herpetology of New Mexico. He currently is the Editor of the New Mexico Herpetological Society Newsletter.

Comparisons. *S. u. tedbrowni* is very similar to *S. u. garmani*, sharing its small body size, reduced dorsal pattern with emphasis on light stripes rather than transverse dark marks, reduction of semeions in males, their absence in females, and femoral pores usually fewer than 15 on each side. The subspecies is distinguished exclusively by its greatly reduced pattern and usually light gray color, remarkably resembling *S. arenicolus* (Figs. 3-5), which is far more common in the Mescalero Dunes area, as is indicated by the 109 specimens from which the latter species was described (Degenhardt and Jones, 1972), whereas the collectors had then found but one *S. undulatus* in the same area. So far as we are aware, the type series of *S. u. tedbrowni* includes all specimens ever taken of that subspecies; it appears to be exceedingly rare. Cole (1975) was the first to report the species from the Mescalero Dunes, and since then only fourteen more have been taken there. We assign subspecific rather than specific rank to the population because of its apparent (inferred) contact and intergradation with its parent subspecies (*S. u. garmani*) and its incomplete differentiation from that forebear (one of twenty specimens of the population appearing like *S. u. garmani*).

Typical *S. u. garmani* occurs northward from the Mescalero Dunes area (Fig. 8), but is confined to parts of a narrow N-S strip between *S. u. consobrinus* on the east, in more humid areas of Texas, and *S. u. tristichus* (Figs. 6, 7, 8) to the west, in the foothills and mountains of central New Mexico. Typical *S. u. garmani* are available from New Mexico a short distance north and east of the Mescalero Dunes, in Lea (Co. line between Milnesand and Crossroads, UNM 1539-42; 3 mi S. Crossroads, UNM 1546) and Roosevelt (2.5 mi W Floyd, UNM 31347; 6 mi N Portales, UNM 15499-500; 8 mi S Clovis, KU 44208-9) counties; none of the 4 males have gular semeions, and their abdominal semeions are small; in the whole series, the femoral pores range from 12-16, mean 13.9. Those that are not discolored have a brightly striped pattern on a brown background; none appears to have been the light gray-brown in life of the dunes race. None exceed the small s-v length characteristic of both *S. u. garmani* and *S. u. tedbrowni*; the largest male is 49 mm s-v, female 65 mm. An intergrade between *S. u. garmani* and *S. u. consobrinus* (TCWC 62964) (Fig. 8), perhaps more closely resembling the former subspecies, is from Yoakum Co., Texas, 10.5 mi E Plains, Hy 380; it is a 55 mm (s-v) male, with faint gular semeions, abdominal semeions narrowly black-margined and separated by 6 (anteriorly) to 13 (posteriorly) scale rows, 14-14 femoral pores but a light brown, spotted dorsal pattern like that of *S. u. garmani*.

S. u. tedbrowni somewhat resembles *S. u. cowlesi* from the White Sands of Otero Co., New Mexico, but the latter is larger (males to 60.2 mm s-v, Lowe and Norris, 1956: 127; females to 69 mm s-v, KU 68998), has both gular and abdominal semeions in both sexes, and has more numerous femoral pores (15-18, mean 16.7).

S. u. consobrinus, which occurs to the south and east in Texas, as well as in southern New Mexico, is similar to *S. u. cowlesi* except for the latter's faded dorsal pattern; hence *S. u. consobrinus* differs from *S. u. tedbrowni* in the same way as *S. u. cowlesi* does, except for dorsal pattern.

Distribution. Although *S. u. tedbrowni* is at present known with certainty only in the Mescalero Sand dune region, it is tempting to conjecture that its geographic range may coincide with that of *S. arenicolus*, which extends spottily southward to the Monahans Sand dune area of western Texas (Fig. 8). The entire transect is peppered with sand dunes resulting from the prevailing winds from the east, blowing off the broad anticline of the Staked Plains and adjacent elevations in eastern New Mexico and western Texas (see account in Axtell 1988: 1). However, *S. arenicolus* has not yet been taken in New Mexico south of the Mescalero Dunes, although numerous localities of record exist in Texas (Degenhardt and Jones, 1972; Axtell, 1988) in Andrews, Winckler, Ward, and Crane counties. In any event, it is possible that *S. u. tedbrowni* occurs with *S. arenicolus* in these and perhaps other counties of both Texas and New Mexico; as rare as it is, it would not be surprising if it has simply been overlooked up to the present time. Otherwise, the subspecies appears to be confined to the Mescalero Sand dunes area. Its parent subspecies, *S. u. garmani* (so assumed), does not occur in the Monahans area and perhaps for that reason *S. u. tedbrowni* may be limited to more northern areas. Specimens examined from Ector Co. (15 mi S Odessa, TCWC 46513; 4 mi W Odessa, 5 mi NNW to J. L. Johnson Ranch, TCWC 46512) and Crane Co. (4.6 mi S Crane, TCWC 62921), Texas, where *S. arenicolus* occurs, are typical *S. u. consobrinus*, dark-colored, striped, with weak crossbars. The male has large paired gular semeions, and a female is 68 mm s-v.

The extraordinary resemblance to each other of the two species of *Sceloporus* occurring in the Mescalero Dunes is undoubtedly the result of convergent adaptation to a shared environment that exerts strong selection pressures upon them, not to mimicry. *S. u. tedbrowni* clearly is marginally syntopic with *S. arenicolus*; the former is partial and perhaps limited to sanctuaries it finds around debris (fence posts, boards, other surface litter) on the dunes, whereas its congener occurs on the dunes proper. Very likely *S. undulatus* is a more recent immigrant into the dunes than *S. arenicolus*, hence its adaptation is less complete and its variation greater. Its very



Fig. 6. *S. u. tristichus*, dorsal pattern, UNM 18777 female (left) and male 18779 (right), from an unknown locality, presumably in New Mexico. Female 72 mm s-v.



Fig. 7. *S. u. tristichus*, ventral markings of same specimens as in Fig. 6.

existence there appears to be more marginal. Association with surface debris differs markedly from the close association of *S. undulatus* (presumably *S. u. garmani*) with sagebrush (*Artemisia filifolia*) in nearby Roosevelt Co., New Mexico, as reported in Gennaro (1972). Similar association of specimens tentatively identified as *S. u. garmani* with *A. filifolia* was reported by Applegarth (1969: 60, 97, 100) 5 1/4 mi. west and 10 1/2 mi. north of Logan in Harding Co., New Mexico.

Relationships

Scope. As at present understood, the *undulatus* group of *Sceloporus* contains only four species, formally designated, in conformance with the 1985 Code (Art. 6, rec. 6B) as follows, in chronological order:

1. *S. (superspecies undulatus) undulatus* (Bosc and Daudin in Sonnini and Latreille [1801])
2. *S. (undulatus) occidentalis* Baird and Girard, 1852
3. *S. (undulatus) woodi* Stejneger, 1918
4. *S. (undulatus) virgatus* Smith, 1938

S. cautus and *S. exsul*, both of which have often been regarded as members of the *undulatus* group, are here considered members of the *spinosus* group, following Ferguson's (1982) unpublished dissertation.

Inasmuch as all four taxa of the *undulatus* group, as here envisioned, are largely allopatric, it is proper to regard the group as a superspecies in both biological (Mayr and Ashlock, 1991: 53-54) and nomenclatural (Code: 11) contexts. Two of its species (*S. virgatus*, *S. woodi*) are monotypic and have small, peripheral ranges, but the other two are extensively polytypic.

Nine subspecies of *Sceloporus undulatus* and six of *Sceloporus occidentalis* are here recognized. They readily fall into five groups or exerges, in the terminology of the 1985 Code (Art. 6, Rec. 6B), as follows:

1.

S. u. (exerge undulatus) undulatus (Bosc and Daudin in Sonnini and Latreille [1801])

S. u. (undulatus) hyacinthinus (Green, 1818)

2.

S. u. (exerge consobrinus) consobrinus Baird and Girard, 1853

S. u. (consobrinus) cowlesi Lowe and Norris, 1956

S. u. (consobrinus) garmani Boulenger, 1882

S. u. (consobrinus) tedbrowni Smith et al., 1991

3.

S. u. (exerge tristichus) tristichus Cope in Yarrow, 1875

S. u. (tristichus) elongatus Stejneger, 1890

S. u. (tristichus) erythrocheilus Maslin, 1956

4.

S. o. (exerge occidentalis) occidentalis Baird and Girard, 1852

S. o. (occidentalis) bocourti Boulenger, 1885

5.

S. o. (exerge biseriatatus) biseriatatus Hallowell, 1854

S. o. (biseriatatus) longipes Baird, 1858

S. o. (biseriatatus) becki Van Denburgh, 1905

S. o. (biseriatatus) taylori Camp, 1916

The S. undulatus Exerges. The *undulatus* and *tristichus* exerges are completely separate, the former being restricted to the eastern half of North America, the latter to the Rocky Mountain area. They are much alike in being strictly scansorial, in their relatively large size (to 137 mm s-v), conspicuously cross-barred (rather than striped), dark (grayish) dorsal pattern, and extensive dark ventral pigmentation. They differ from each other in habits (the *undulatus* exerge being basically arboreal, the *tristichus* exerge saxicolous although often in forested areas), and in semeion distribution (the western *tristichus* exerge having well developed semeions in females as well as in males, but not in the eastern *undulatus* exerge; see Figs. 4,5).

The *consobrinus* exerge occupies the Great Plains area between the other two exerges, from South Dakota southward through central and western Texas, westward south of the Rocky Mountains into central southern Arizona, and southward onto the northern plateau of Mexico. It is distinguished from the other two exerges by its terrestrial (not scansorial), cursorial habits, smaller size (not exceeding 70 mm s-v), usually striped, sometimes mottled, never prominently dark cross-barred dorsal pattern, paler (brownish, very pale in some) dorsal ground color, reduction in ventral pigmentation in both sexes, and reduction of the semeions.

The least perfect conformance with the concept and its rationales occur in *S. u. consobrinus*, whose extensive range is somewhat eurytopic; it is also the largest member of its exerge, and has the most elaborate semeions in males, reflected to some extent in females. Otherwise it conforms well with the common characteristics of its exerge. Its features nevertheless, in conjunction with its direct linkage with all three exerges (*undulatus* to the east, *tristichus* to the northwest, its own occurrence to the north, southwest and south), suggest that it is as close to conformance with a common ancestor of all three exerges (and to the two monotypic species of the group; see ff.) as can be found extant at the present time.

The three exerges of *S. undulatus*, each with its 2-4 subspecies, reflect as three distinct units, three comparable units of ecological situations; each lizard and ecological unit, although varying geographically, maintains a basic similarity throughout.

For example, within the range of the species are at least two sets of extensive sand dunes; the White Sands of New Mexico and the white Mescalero-Monahans dunes of New Mexico and Texas (Fig. 8). The adaptation was basically the same in each case, involving evolution of a cryptically advantageous, very light, nearly patternless dorsum; scale characters make it clear that the two bleached subspecies evolved completely independently, one (*S. u. cowlesi* on the White Sands) from the surrounding *S. u. consobrinus*, the other (*S. u. tedbrowni* on the Mescalero-Monahans dunes) from the adjacent *S. u. garmani*.

The entire *consobrinus* exerge is adapted for crypsis and speed in its open habitats, which are highly susceptible to strong selection pressure from predators; the small size, light coloration, striped pattern and subdued semeions all appear to be adaptations minimizing predation pressure, and the bleached subspecies have carried those adaptations to a conspicuous extreme. All of the adaptations correlate with celerity - speed of movement.

The *undulatus* and *tristichus* exerges exhibit the larger sizes and

flamboyant semeions that accompany freedom from severe predation pressure; their cryptic, dark coloration and disruptive pattern thwart predation through immobile concealment in or near shadows on rocks or trees, rather than by fast movement.

The differentiation that has occurred in this widely distributed species thus appears to reflect a profound environmental effect upon the direction of evolution exemplified by its various subspecies, with several examples of convergent results, and a remarkable built-in genetic plasticity that permits relatively prompt adjustment to different environmental situations.

That such a response is possible is evident in consideration of the other members of the *undulatus* group in North America. *Sceloporus occidentalis* of western North America, although known to be specifically distinct from *S. undulatus* (Bell, 1954b; Cole, 1983), is certainly superspecifically related, almost completely allopatric with *S. undulatus*.

The S. occidentalis Exerges. Both sexes in this species have semeions, with the males having more prominent ones. Gular semeions are entire and large in the *biseriatus* exerge, but divided, or quite diminutive to the point of extinction, in the *occidentalis* exerge.

This species is divisible into two exerges on the basis of size, ventral coloration, and diminution or enlargement of the blue in the semeions. The *biseriatus* exerge includes the larger four subspecies. The larger size is apparently related to a larger egg, and presumably more yolk.

Snout-vent lengths (Bell, 1954a) are summarized in Table 2. The *biseriatus* exerge, which is in the warmer parts of the species range, is presumed to have given rise to the *occidentalis* exerge, occupying the cooler parts of the range. The comparisons made are based upon all specimens measured, except for presumed intergrades, with the percentages figured of those with s-v lengths of 75 mm or higher/ the total number of s-v lengths 60 mm. or higher, here expressed as 75 mm/ 60 mm%. This manner of comparison eliminates the effect of the shorter subadults and juveniles influencing these percentages. All four subspecies in the *biseriatus* exerge have larger percentages than the two subspecies in the *occidentalis* exerge. The coastal California *S. o. longipes* (Area II) have a lower percentage of 75 mm/ 60 mm% (21.9%), than do the *S. o. longipes* in Area I in the Great Basin and Columbia River Plateau (51.06%). This might be associated with the lower temperatures of the coastal climate. *S. o. biseriatus* in the San Joaquin Valley with a figured percentage of 52.0%, and *S. o. taylora* with 82.8% retain the higher percentages. *S. o. becki*, occupying the Channel Islands just

offshore from Santa Barbara County, California, have the lowest 75 mm/ 60 mm% in the *biseriatus* exerge, again perhaps being associated with the cooler climate of the coast. *S. o. taylori*, with its range in the presumably cooler Sierra Nevada of California had a 75 mm/ 60 mm% of 82.8%. This latter subspecies is the only one in the *biseriatus* exerge that has not, based upon these data and manner of comparison, evolved smaller s-v lengths in a presumably cooler environment. Ancestry of the *biseriatus* exerge with a larger egg seems to have mitigated the presumed effect of temperature in *S. o. taylori*. *S. o. biseriatus* in the San Joaquin Valley (52.0%) is essentially identical with the presumed ancestral *S. o. longipes* in the Great Basin and Columbia River Plateau (51.06%). In making this general comparison between s-v lengths and presumed ancestry in warmer and cooler regions, we realize that individuals may choose to inhabit and/or reproduce in temperatures of an area to which they are adapted, irrespective of the overall general measured climate of the range. Nevertheless, the association of s-v lengths seems to be of great interest.

S. o. longipes (*biseriatus* exerge) seems to have evolved a larger egg, which seems to be associated with larger s-v size of hatchlings, and *S. o. occidentalis* (*occidentalis* exerge) seems to have evolved a smaller egg and smaller s-v lengths of hatchlings according to the studies of Sinervo (1990) and Sinervo and Huey (1990). Removal of yolk in early development from eggs of females of the *biseriatus* exerge miniaturized the size of the experimental lizards hatchlings to approach that of the *occidentalis* exerge hatchlings.

The lizards used by Sinervo (1990) were collected near Pearblossom and Table Mountain, near Wrightwood in Los Angeles County, California (*S. o. longipes*), and from near Lyle, Washington, and near Terrebonne, Oregon (*S. o. occidentalis*). He states (1990: 282) that egg size "was determined by at least four of the female's phenotypic traits at the time of laying." He lists these traits as (1) female size, (2) egg-laying date, (3) female condition, and (4) residual clutch size. An analysis of these four factors was done by him. Mean egg masses for *S. o. longipes* near Wrightwood were .62 g [California, high elevation, 2230 m]; at Pearblossom .57 g [California, low elevation, 1330 m]. Mean egg masses for *S. o. occidentalis* near Terrebonne were .46 g [Oregon, 750 m elevation]. In comparing California and Washington lizards, he showed that mean clutch size increased from seven per clutch in the south (California) to twelve eggs per clutch in the north (Washington). Also egg size in the south (California, .65 g) was greater than in the north (Washington, .40 g). More such studies on the nature of the maternal investment in the egg may contribute to greater understanding of the evolution in these exerges' populations.

Mature males of the *biseriatus* exerge subspecies have, in *S. o. biseriatus* and *S. o. longipes*, a transverse blue gular semeion; in *S. o. becki* a large blackish gular semeion with black lines radiating toward the lips; and in *S. o. taylori*, in males above 80 mm s-v, the entire ventral surface of blue uniting the gular and abdominal semeions from just anterior to the vent nearly to the tip of the chin. This latter subspecies, a form adapted to the Sierra Nevada of California above 7,000 feet, is clearly the most colorful in the entire *undulatus* group. In the *occidentalis* exerge, *S. o. occidentalis* males have gular semeions varying from blue gular area with a narrow light line separating the lateral blue semeions, to paired, completely separated blue gular semeions. *S. o. bocourti* males (*occidentalis* exerge) display diminution to almost complete extinction of the blue gular semeions. Ventral coloration, exclusive of the semeions, but including the interabdominal semeion area, chest, and ventral surfaces of the legs are much darker in the *biseriatus* exerge than in the *occidentalis* exerge. *S. o. biseriatus*, *S. o. taylori*, and *S. o. becki* (an insular subspecies) have smaller scales, as evidenced by the higher counts of dorsal scales, ventral scales, and scales around the body, than does *S. o. longipes*.

The *S. occidentalis* exerges parallel in adaptive contexts the *tristichus* and *undulatus* exerges collectively of *S. undulatus*, all being large, scansorial, dark-colored, cross-barred and having relatively prominent semeions.

The Monotypic Species of S. (undulatus). There is no equivalent of the *consobrinus* exerge, however, in *S. occidentalis*, but two independent ones exist. One occurs on the east coast in the relatively open, flatland environment of central Florida: the diminutive, light-colored, longitudinally-patterned, terrestrial and cursorial *S. woodi*. Jackson (1973: 756) indicates a possible origin of *S. woodi* from *S. virgatus* or *S. u. consobrinus*; the latter is far more likely.

The other is the somewhat similar *S. virgatus* of southeastern Arizona, southwestern New Mexico, and the northern Sierra Madre Occidental of Mexico. It is a mountain forest inhabitant and is also small, terrestrial, striped and with discrete semeions. The abdominal semeions are completely absent, and the gular semeions are small paired blue spots in males and orange spots in females in the breeding season (Cole, 1963; Vinegar, 1972). Breeding season color changes have been noted also in *S. u. erythrocheilus*, not in the semeions, but as yellow or orange on the chin in both sexes (Maslin, 1956; Rand, 1991).

Seasonal semeion changes are conspicuous in the so-called intergrades between *S. u. garmani* and *S. u. erythrocheilus* (Smith et al., 1991; HMS, pers. obs.) (Fig. 8), and may well occur under hormonal control in many other species and subspecies of the genus (Rand, 1991).

S. virgatus appears to be on an evolutionary trajectory different from that of the adjacent *tristichus* exerge of *S. undulatus*. *S. virgatus* could well have been derived from progenitor populations similar to *S. u. consobrinus*, as very likely was *S. woodi*.

To what extent the several exerges of *S. undulatus* and *S. occidentalis*, and the other members of the *undulatus* group, are held together by phylogenetic trajectories rather than adaptive convergence, and to what extent each population may interact directly with the environment, remains to be explored.

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Table 1. Variation in the type series of *S. u. tedbrowni*.

Museum No.	Sex	s-v (mm)	Dorsals	Scales around Body	Femoral Pores	Interfemoral Scales
UNM 52063	M	54	40	42	16-15	4
UNM 33859	M	49	41	46	16-16	4
UNM 33888	M	47	38	42	14-14	5
AMNH 110057	M	46	-	-	-	-
UNM 52062	M	45	41	42	13-14	6
UTEP 11077	M	45	40	40	15-17	5
UTEP 11078	M	44	41	41	14-15	5
UNM 14144	M	39	43	43	15-16	6
UNM 37105	M	36	40	41	15-16	4
UNM 33823	M	31	41	41	15-16	5
UNM 37106	M	30	44	-	13-14	4
UNM 52065	F	59	41	47	16-15	4
UNM 52061	F	58	43	43	16-13	5
UNM 37107	F	57	42	43	14-14	4
UCM 56276	F	53	39	46	14-14	4
UNM 52064	F	51	44	40	14-14	5
UNM 14825	F	50	41	44	14-14	5
UCM 56277	F	49	43	40	14-15	4
UTEP 11079	F	49	43	42	15-16	3
UNM 37108	F	25.5	40	-	13-14	5

Table 2. Snout-vent length comparisons of *Sceloporus occidentalis* subspecies; largest specimens of both sexes, with localities.

EXERGE	SUBSPECIES PERCENTAGES: Nos. 75 mm. and above/ nos. 60 mm. and above x 100 = %	LARGEST MALE; MUSEUM NO. & LOCALITY	LARGEST FEMALE; MUSEUM NO. & LOCALITY
<i>occidentalis</i>	<i>S. o. occidentalis</i> : 34/668 = 5.1%	84 mm MVZ 32658 Napa. Co., CA	89 mm CAS 30637 Shasta Co., CA
<i>occidentalis</i>	<i>S. o. bocourti</i> : 5/179 = 2.79%	82 mm SBMNH 10221 Santa Barbara Co., CA	79 mm MVZ 27637 Alameda Co., CA
<i>biseriatus</i> (Area I) Great Basin, Columbia River Plateau	<i>S. o. longipes</i> : 272/478 = 51.06%	91 mm USNM 11772 Nevada State	79 mm SBMNH 24320 Santa Barbara Co., CA
<i>biseriatus</i> (Area II) Coastal Calif. and Baja Calif.	<i>S. o. longipes</i> : 69/228 = 21.9%	85 mm MVZ 41689 Riverside Co., CA	93 mm OS 650 Harney Co., OR
<i>biseriatus</i>	<i>S. o. biseriatus</i> : 89/171 = 52.0%	93 mm CAS-SU 3233 Tulare Co., CA	97 mm SDSNH 1225 San Diego Co., CA
<i>biseriatus</i>	<i>S. o. taylort</i> : 29/35 = 82.8%	94 mm MVZ 3510 Tulare Co., CA	95 mm CAS 3898 Kern Co., CA
<i>biseriatus</i>	<i>S. o. beckett</i> : 8/59 = 13.5%	94 mm SBMNH 8097 Fresno Co., CA	84 mm MVZ 5936 Yosemite Natl. Park
		80 mm SDSNH 18313 Santa Cruz Is.	75 mm SDSNH 17211 & 18411, Santa Cruz Is.

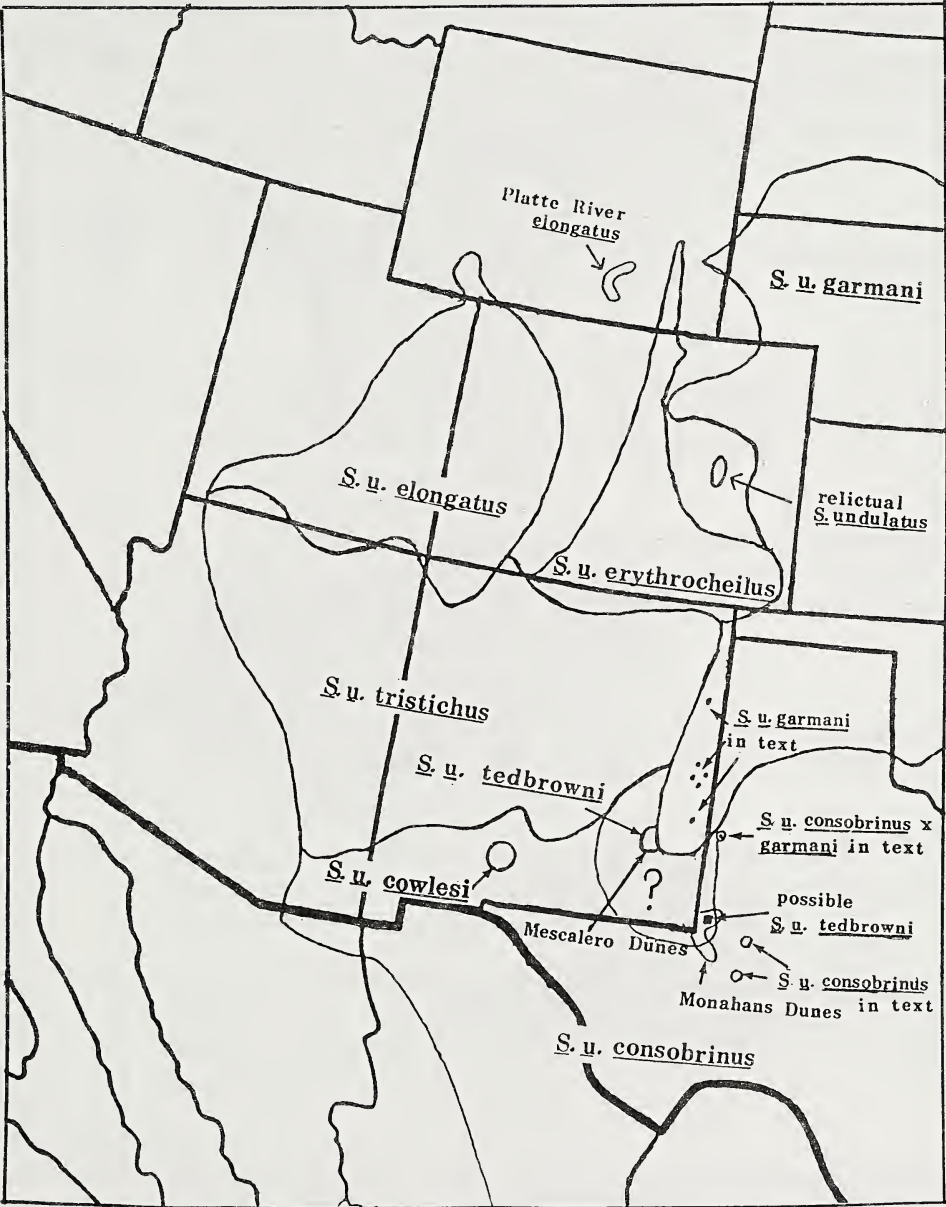


Fig. 8. Map showing location of the Mescalero Sand Dunes, with locality records in text, and the local distribution of their associated subspecies of *Sceloporus*.

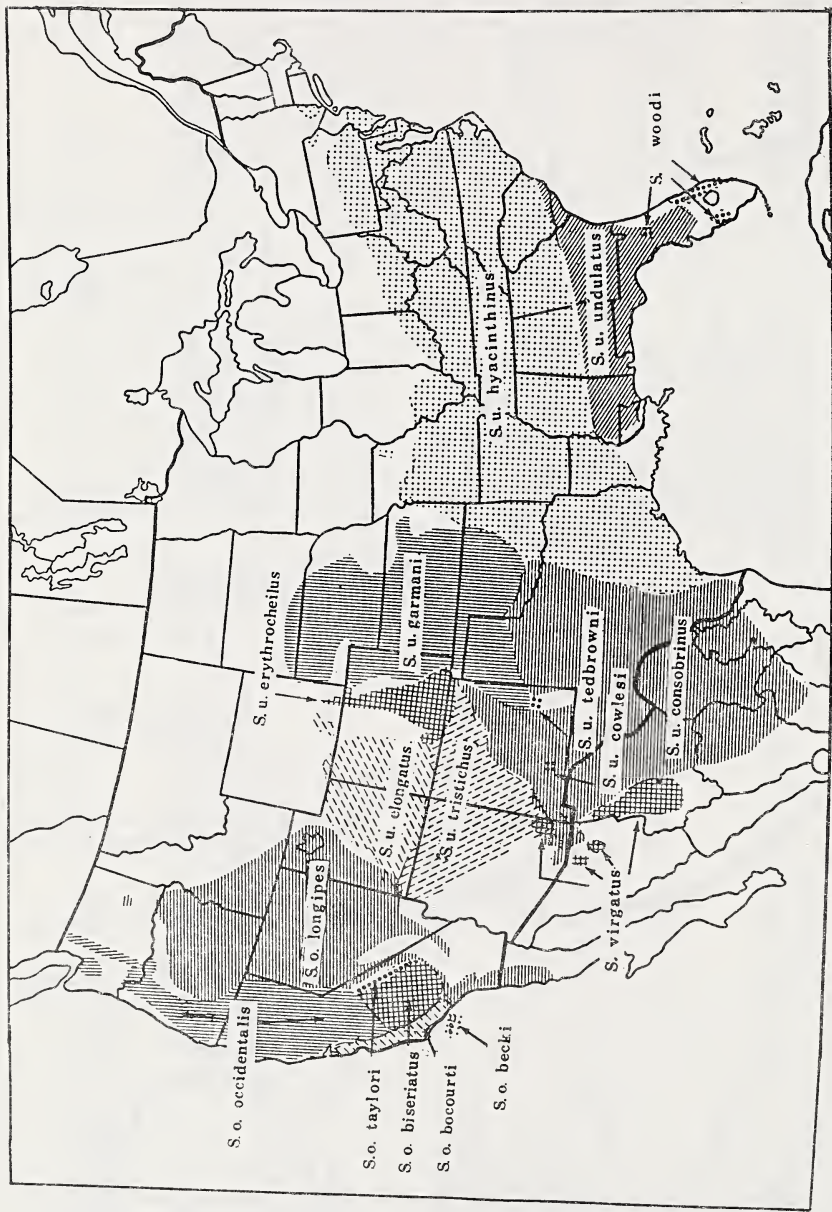


Fig. 9. Map showing distribution of the four species and subspecies in the *Sceloporus undulatus* superspecies. Intergrade areas are not indicated.

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NATURAL HISTORY NOTES ON A SMALL POPULATIONS OF *ANOLIS BREVIROSTRIS* (SAURIA:POLYCHRIDAE) FROM ALTERED HABITAT IN THE DOMINICAN REPUBLIC

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Donald D. Smith, and Amy Lathrop

In an altered habitat we examined aspects of natural history in a small population of *Anolis brevirostris*, a trunk anole endemic to Hispaniola. Males were significantly larger than females. Sex ratios favored males, but were not significantly different from an expected 1:1 ratio. Habitat preferences were for larger broadleaf trees, among which lizards moved freely, and of which the trunks and larger limbs were used most frequently. Members of this lowland population appeared to be thermal conformers. Three distinct types of behavior were observed in males and females in a variety of situations. Joint-stepping was not restricted to prey approach, but used in intraspecific interactions as well. Males demonstrated aggression and territoriality. Interspecific interactions were limited to a few aggressive encounters with green anoles, *A. chlorocyanus*. Both sit-and-wait strategies and joint-stepping were used in feeding, most of which involved prey (largely ants and beetles) on tree surfaces. Larger individuals did not select larger food items and no significant differences in prey selection existed between males and females. The nematode *Skrjabinoptera leiocephalorum* is reported for only the second time from an anole.

Anolis brevirostris is endemic to Hispaniola and distributed over the south-central part of the island and on many satellite islets (Schwartz and Henderson, 1991). These lizards are associated primarily with xeric habitats, but can be found in semimesic to mesic forests. *Anolis brevirostris* has been described as a trunk dweller (Williams, 1983) and prefers larger trees in forested areas, but is also found on fence posts, vines, shrubs, and on the ground under palm logs, stacks of palm fronds, and in coconut piles (Arnold, 1980). Ruibal (1965), Moermond (1981), and Jenssen and Gladson (1984) described behavior. Previous field work took place in essentially natural habitats, however, and since *A. brevirostris* is among several species of Hispaniolan anoles that have adapted well to altered areas, we address aspects of natural history in a small population of *A. brevirostris* in a heavily-trafficked park near the Hotel Guarocuya in Barahona, Dominican Republic.

Methods

Anolis brevirostris wetmorei from Barahona, Barahona Province, Dominican Republic were studied over a thirteen day period in June 1991. The ca. 750 m² study site is a heavily used parkland situated near the southern edge of the city, approximately 35 m from the beach and 40 m north of the Hotel Guarocuya parking lot. The area contained sixteen broadleaf and palm trees planted in rows. To facilitate accurate recording of locations and perch heights, each tree and major branch was numbered, and lines were drawn around each tree and branch at one meter intervals up to four meters. Other lizards in the study area included ground-dwelling *Leiocephalus schreibersii*, *Ameiva chrysolaelma*, *Celestus costatus*, largely arboreal *Anolis cybotes*, *Anolis chlorocyanus*, and *Anolis olssoni*, a grass anole.

Individuals were noosed, sexed, measured, uniquely marked with paint to allow rapid recognition without resorting to recaptures, and toe-clipped for permanent identification. Cloacal temperatures and those of substrate and air at 2 cm and 1 m were taken with a cloacal quick-reading thermometer (Miller and Weber, Inc., Queens, New York). Environmental temperatures were taken in the shade and sheltered from wind. Population size was estimated using the Lincoln-Peterson index (Pacala and Roughgarden, 1985). The Schnabel method (Tanner, 1988) was used to evaluate if most or all of the animals were caught. Because these anoles are arboreal, ecological density (per tree) was computed in addition to crude density (by unit area). Lizards seen on branches extending outside of the study site boundaries were included if the tree trunk was within the plot.

Seventeen specimens were collected outside the study site and preserved for stomach content analysis. Two additional specimens, collected in Barahona in May 1989, were also examined. Stomachs were excised and ingested food items were counted and identified to order. Volumes of contents were measured using methods of Milstead (1957), and importance values of food items were calculated according to Powell et al. (1990b). All means are presented plus or minus one standard deviation, and for all statistical tests, $\alpha \leq 0.05$.

Results and Discussion

SIZE AND SEX RATIO.—Snout-vent lengths (SVL) of 47 adult males (41-52 mm, $\bar{x}=48.5\pm2.4$ mm) were significantly longer than those of 33 adult females (38-46 mm, $\bar{x}=41.4\pm2.1$ mm) (DF=78, $t=-13.7$, $P<0.001$). The sex ratio (M:F) in the focal population was 33:27, that for the 19 lizards used in the investigation of food habits was 14:5. Neither the observed sex ratios in

the focal population ($DF=3$, $\chi^2=0.30$, $P=0.96$), the anoles taken for stomach analysis ($DF=3$, $\chi^2=2.26$, $P=0.52$), nor both combined ($DF=3$, $\chi^2=1.44$, $P=0.70$) differed significantly from an expected 1:1 ratio. The higher (but statistically insignificant) number of males may be explained by sampling error, as males of most iguanian species (*sensu* Frost and Etheridge, 1989) are likely to be more frequently encountered than females (Carpenter, 1967). This was most obvious in the sample taken for stomach content analysis, when the first 17 animals seen were captured, and no efforts were made to collect a representative sample or all of the lizards in a given area.

POPULATION SIZE AND DENSITY.—The focal population size was estimated as 57 ± 1.77 (Lincoln-Peterson index). This does not account for immigration or emigration, both of which may have occurred. The Schnabel method indicated actual population size was approached. The mean number of lizards per tree was 3.6 and the crude density per unit area was 1 lizard/13 m² (~800/ha). Although comparisons with populations in more natural locations are not available, these data indicate that *A. brevirostris* is capable of attaining high population densities in altered areas with considerable human activity.

HABITAT UTILIZATION.—Home ranges were not computed because of the difficulties associated with animals in three-dimensional habitats. Fitch et al. (1989) addressed this issue by calculating cylindrical areas used by trunk-dwelling *Anolis cristatellus*, but *A. brevirostris* often forages high into trees (despite their categorization as trunk-dwellers) where the number of small branches precluded accurate measurements of all substrates utilized. Furthermore, lizards readily moved from tree to tree, three instances of which were observed. In all, of 43 animals resighted at least once, 19 were observed on two different trees, five were seen on three different trees, and two were observed on four separate trees. Seventeen were seen only on the same tree. Eighteen individuals were not observed again after their initial capture.

Lizards were found on all three of the larger broadleaf species in the area (*Aleurites molucana*, *Cassia siamea*, *Terminalia catappa*) and moved between them freely; only 8 individuals (and almost always juveniles) were found on palms or smaller broadleaf trees. We recorded perch heights for 177 observations during which the lizard was seen before it moved (multiple observations of any individual were included only if from different days). Perch heights of adult males ($N=125$, 0.1–4.5 m, $\bar{x}=2.1 \pm 1.1$ m) were significantly greater than those of adult females ($N=46$, 0.1–3.2 m, $\bar{x}=1.4 \pm 0.9$ m) (Mann-Whitney U, $Z=-3.62$, $P<0.001$). On only two occasions did we see individuals on the ground, but grit found among stomach contents of two animals suggested that these lizards, at least occasionally, forage on the

ground. Other trunk-dwelling anoles, *A. cybotes* and *A. distichus*, were observed to forage on the ground far more frequently in habitats (montane areas and confined sites, such as courtyards) in which ground-dwelling *Ameiva* and *Leiocephalus* were less common (or absent) than in the study area. Though quantitative data are lacking, we believe time spent on the ground by these anoles may be restricted by the presence of other, potentially competing species.

THERMAL REGIME.—Cloacal temperatures ($N=54$, $28.2\text{--}32.6^{\circ}\text{C}$, $\bar{x}=30.6 \pm 3.4^{\circ}\text{C}$) were significantly correlated with substrate temperatures ($N=45$, $25.6\text{--}31.8^{\circ}\text{C}$, $\bar{x}=28.7 \pm 3.2^{\circ}\text{C}$; $N=39$, $r=0.43$, $P<0.01$), air temperatures at 2 cm ($N=50$, $25.2\text{--}32.2^{\circ}\text{C}$, $\bar{x}=28.7 \pm 1.7^{\circ}\text{C}$; $N=44$, $r=0.61$, $P<0.001$), and air temperatures at 1 m ($N=50$, $25.0\text{--}32.3^{\circ}\text{C}$, $\bar{x}=28.6 \pm 1.5^{\circ}\text{C}$; $N=44$, $r=0.37$, $P<0.02$). Comparisons are given in Figure 1. Cole (1943) stated that substrate temperatures are more relevant to body temperatures than are air temperatures, because heat is primarily absorbed from the sun and the substrate. However, P. E. Hertz (pers. comm.) stated that substrate temperatures are not relevant to a small arboreal lizard, but the higher correlation in this study between cloacal and substrate temperatures than with air temperatures indicated that at least some heat exchange occurred with the substrate.

Well-defined basking behavior was not observed. Most observations (94/116, 81%) were of individuals in shade (lizards often followed the shadows as they made their way around a tree in the course of a day), rarely (22/116, 19%) in diffuse sunlight, even during early morning or evening periods. Individuals were observed in direct sunlight only when disturbed by human activities. Activity periods extended from dawn until dusk. The combination of consistently warm weather, low elevation, and a largely shaded area seemed to provide suitable temperatures for optimal activity without the need for active thermoregulatory behavior. Hertz and Huey (1981) observed similar situations in their study of other species of Hispaniolan *Anolis*.

BEHAVIOR.—Display behaviors of *A. brevirostris* were described by Jenssen and Gladson (1984), who defined type-A behavior as 5-7 bobs often followed by dewlapping. Bobs are presumably the push-ups of Ruibal (1965), who made a distinction between these actions. Because type-A behavior is common, and we only observed 6 instances of head bobbing (as described by Ruibal, 1965), we follow Jenssen and Gladson (1984) in not distinguishing between the two. Type-A displays are not always directed and may be used by patrolling males or employed after eating, defecating, or in copula. Type-B behavior, restricted to definite intraspecific interactions by Jenssen and Gladson (1984), was described as a series of bobs (= push-ups

of Ruibal, 1965) with simultaneous dewlapping. Type-C behavior is described here because observed behaviors did not all fall into previously defined categories. This behavior included tail-lashing and upraising (except during defecation) and is most often seen in combination with other behavior types (Jenssen and Gladson, 1984). Joint-stepping was similar to advances described by Moermond (1981) in association with feeding behavior.

Of 156 total field observations of behavior, 91 were characterized as type-A behavior, 31 involved dewlapping, 17 push-ups, and 43 push-ups followed by dewlapping by either one or more lizards in a given encounter. Although Jenssen and Gladson (1984) did not observe type-A behavior in females, in this study two female *A. brevirostris* were seen bobbing during copulation. Also, while Jenssen and Gladson (1984) included tail upraising in *Anolis caudalis* type-A behavior, but not in that of *A. brevirostris*, we observed tail upraising during intraspecific interactions five times in the course of this study.

Seven different males displayed type-B behavior, on one occasion repeatedly. Two of these incidents also involved tail-lashing. Type-C behavior, alone or in combination with other behaviors, was observed on ten separate occasions by eight different individuals, only one a female (during pursuit by a male). Six of these incidents involved tail-lashing (always by males), and on two occasions (same individual) followed by tail-upraising. All observed type-C behaviors were directed. We observed joint-stepping separate from feeding behavior a total of 24 times, always involving cautious approaches or avoidance of other individuals.

Many of the male-male interactions were categorized as aggressive, based on observations of type-A or B behavior, chasing, and/or biting. Though actual intent could not be determined, 21 incidents appeared to involve protection of a territory or a female within the area being protected, usually a branch or group of branches at nearly the same height. Four instances of aggressive male-male interactions were the result of intentional introductions of males into the vicinity of another male. In one case no aggressive action occurred. On the other three occasions, the introduced male was chased upward. None of the introduced males displayed any aggressive behavior, but all three of the resident males exhibited both type-A and B behavior during the encounters. Because chases are so rapid, it was difficult to observe biting action, although in one instance an introduced male was bitten three times while being chased. This individual took sanctuary on a terminal leaf. The resident male attempted an approach but failed. This was the only observation of an *A. brevirostris* on a leaf. Two of three introductions of females onto distant trees resulted in apparent acceptance by resident males, on the other occasion the introduced female

was chased and bitten twice by a male. No incidents of female-female aggression were observed.

Six instances of displacement were observed. One was a male-male interaction in which an aggressor chased another from its perch, then took its place. The other five incidents were male-female interactions in which the male would move, followed by the female taking his spot. No apparent aggression was evident in these encounters.

Williams (1983) described the primary escape behavior of trunk anoles as squirreling, upon disturbance lizards initially move to the opposite side of a branch or trunk, but will take refuge higher in the tree if provoked further. We observed escape behavior as a result of intra- and interspecific interactions, and in response to disturbance by humans. Most individuals reacted proportionately to the threat posed, squirreling, then crawling up the tree or out on limbs in increments upon being approached. In 41 of 46 recorded incidents involving responses to human observers, lizards moved upward and/or outward (four moved to different branches and one to a different tree), in 10 cases movement was accompanied by type-A behavior. On no occasions involving humans was a downward escape observed. In the five incidents during which lizards remained stationary (one turned to face upwards but did not ascend), three involved some form of type-A behavior. Of 22 male-male interactions recorded, nine involved chases of which eight concluded in upward or outward escapes. Four of these encounters involved type-A behavior. On one occasion a male *Anolis chlorocyanus*, a species usually observed at greater heights than *A. brevirostris*, chased an *A. brevirostris* upwards and bit it as it approached a female *A. chlorocyanus*. Near, but outside, the study area another male *A. chlorocyanus* was observed chasing a male *A. brevirostris* down the trunk, apparently the threat sufficient to overcome the lizard's more commonly observed reluctance to escape downward. In addition to *A. chlorocyanus*, *A. cybotes* were found syntopically with *A. brevirostris*, but other than the incidents described above, no interspecific interactions were observed.

Observations of reproductive behavior, in addition to displays and pursuits described above, included five incidents of copulation. In four cases lizards were facing down, in the other case orientation was not recorded. Twice the male was on the female's right side, once on her left. Positions were not noted in the other two incidents. During copulation, males demonstrated combinations of type-A (N=5) and C (N=2) behavior. Type-A behavior was also observed in two females, although Jenssen and Gladson (1984) did not associate this behavior with females in copula. When finished, the pairs abruptly separated, whereupon the female ran up the tree in three instances and remained still in another sighting. Male post-

copulatory behavior included type-A behavior on two occasions, one of which also involved type-C behavior (push-ups with the tail upraised).

FOOD HABITS.—Of 24 recorded observations of prey capture, 16 involved a sit-and-wait strategy and in eight instances joint-stepping was noted. Moermond (1981) described advances, herein called joint-stepping, as a prey attack behavior of trunk anoles (although, as noted above, we saw it utilized more frequently in cautious approaches to other individuals). In 20 sightings, *A. brevirostris* captured and consumed prey on the tree, most likely ants (judging from both stomach analysis and the abundance of ants seen on the trees). Three times lizards were also seen attempting to capture flying insects (none successfully). On two occasions lizards were seen walking or jumping backwards in order to catch an insect.

Analysis of stomach contents (Figure 2) indicated that ants and beetles were the most important food items. One stomach contained plant material and 2 contained grit, most likely from adventitious ingestion during prey capture, in the latter case probably on the ground. Foraging on the ground is not uncommon in trunk anoles (Rand, 1962; Williams, 1983), although we observed no such incidents. Surprisingly, as larger individuals might be expected to consume larger food items, mean size of food items decreased slightly, although not significantly, with increased SVL ($N=19$; $r=-0.09$, $P=0.37$). Importance values of different food items did not differ significantly between sexes ($DF=12$, $t=0.002$, $P=0.99$).

PARASITISM.—*Skrjabinoptera leiocephalorum* (Nematoda: Physalopteroidea) previously had been found only in *Leiocephalus* spp. (Greve and Powell, 1989; Powell et al., 1990a, c). Two male *Skrjabinoptera leiocephalorum* were found in stomachs of *A. brevirostris*, admixed with ingesta. In a study synchronous with this one (Fobes et al., 1992), *Skrjabinoptera* sp. (but probably *S. leiocephalorum*) were also found in *A. cybotes* from a nearby site in Barahona. Prevalence was 0.16 (3 of 19 stomachs examined). Intensities were one in both host specimens.

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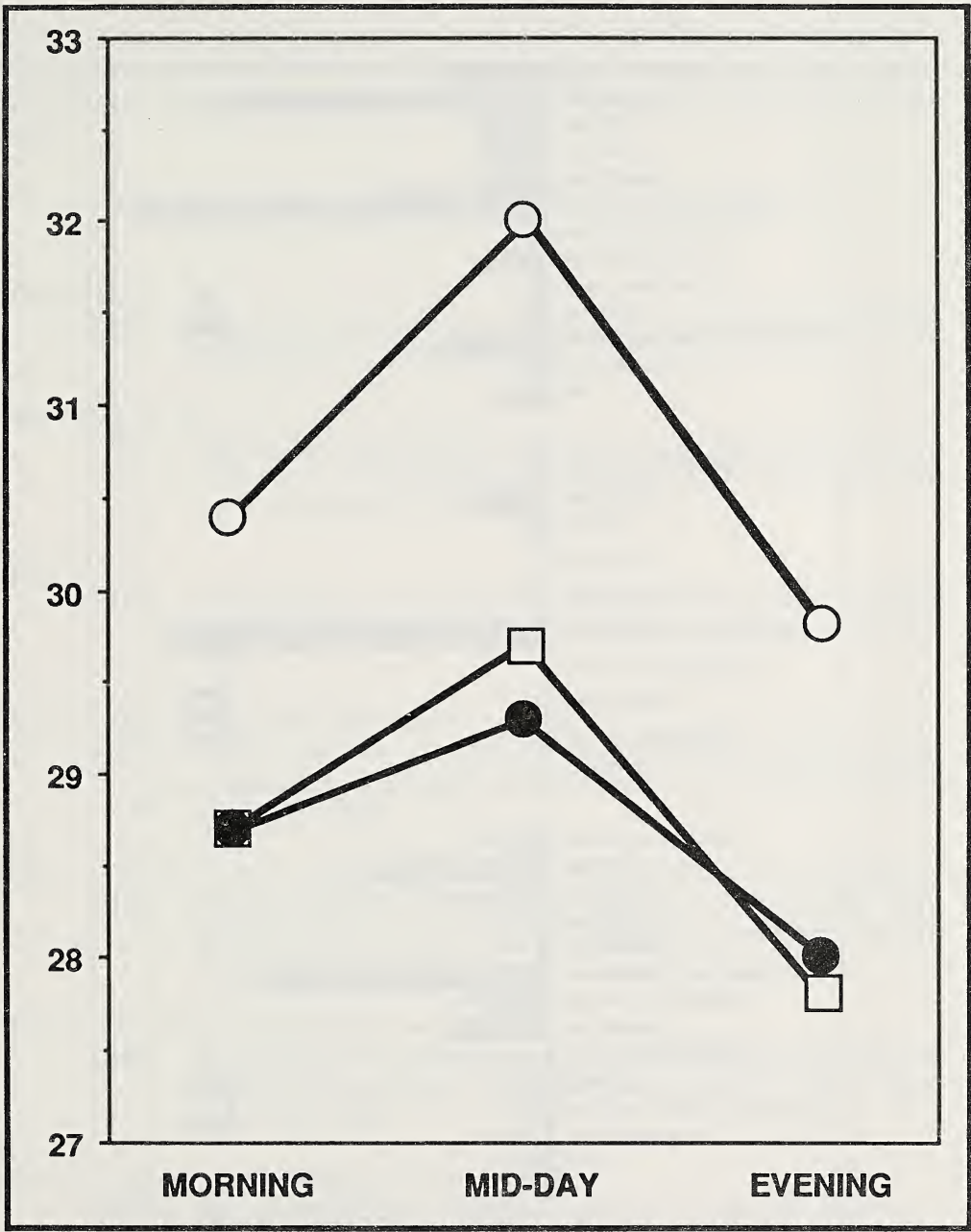


Fig. 1. Temperature data for *Anolis brevirostris* from Barahona, Dominican Republic: mean cloacal (open circles), substrate (squares), and air (solid circles) temperatures during morning (0500-1100 hrs) (N=13), midday (1100-1600 hrs) (N=14), and evening (1600-2100 hrs) (N=21) periods.

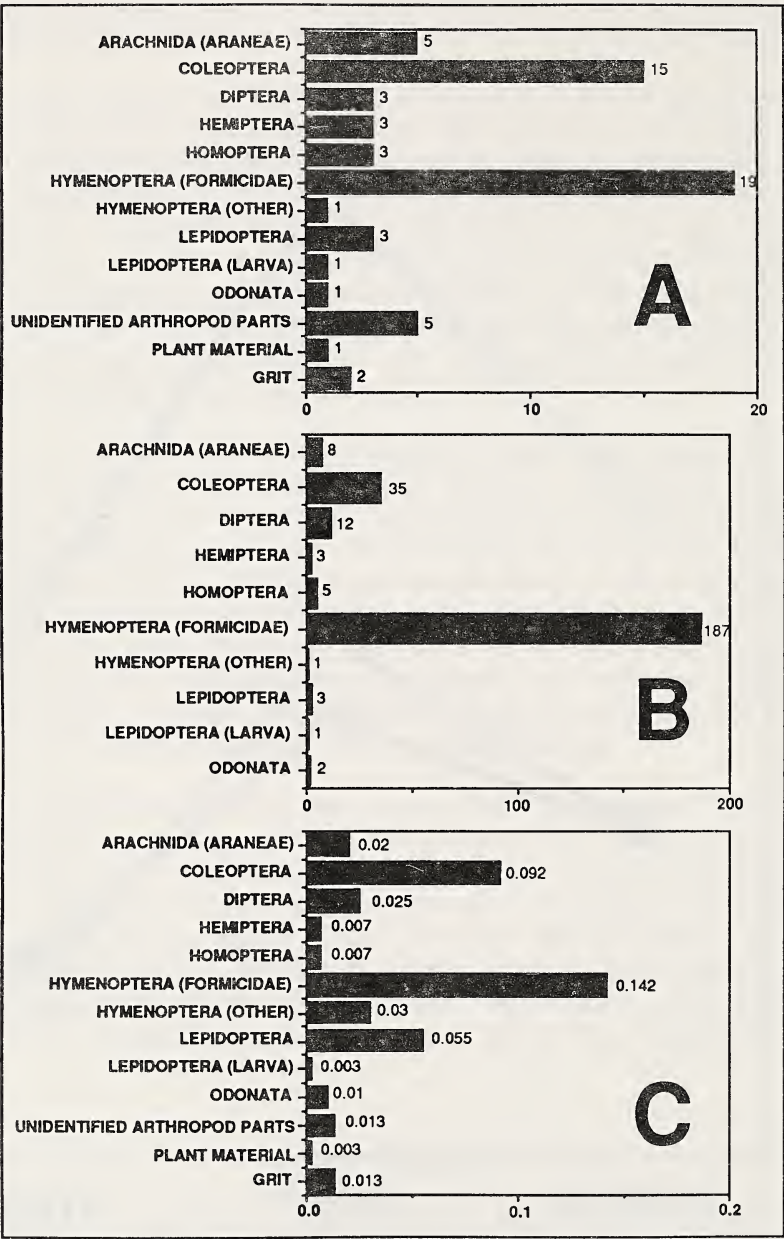


Fig. 2. Stomach contents of *Anolis brevirostris* (N=19) from the Dominican Republic: (A) frequencies of occurrence of each item (numbers of stomachs in which each item was found); (B) total numbers of each item; (C) total volume of each item in mm³.

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BOELLA TENELLA IS EPICRATES INORNATUS
(REPTILIA: SERPENTES)

Van Wallach and Hobart M. Smith

The holotype of *Boella tenella* Smith and Chiszar (1992), supposed to be from the state of Oaxaca, Mexico, actually represents *Epicrates inornatus* (Reinhardt) and is accordingly from Puerto Rico.

Erroneous or unknown locality data on type material for newly described onomotaxa (nominal taxa) have plagued herpetological research from the beginning of taxonomic time (Linnaeus, 1758) to the present. Many such taxa, to be sure, are rather promptly placed with their proper biotaxa, resulting in no long-enduring problems. Examples are: *Anilius scytale* (Linnaeus, 1758) of northern South America (type locality "Indiis"); *Conopsis nasus* Günther (1858) of central Mexico (type locality "California"); *Drymobius margaritiferus* (Schlegel, 1837) of Texas, Mexico and Central America (type locality "New Orleans"); *Epicrates fordii* (Günther, 1861) of Hispaniola (type locality "western Africa"); *Helicops angulatus* (Linnaeus, 1758) of northern South America (type locality "Indiis"); *Helicops trivittatus* (Gray, 1849) of Brasil (type locality "India"); *Hypnale nepa* (Laurenti, 1768) of Sri Lanka (type locality "America"); *Lamprophis aurora* (Linnaeus, 1758) of South Africa (type locality "America"); *L. fuliginosus* (Boie, 1827) of Africa (type locality "Java"); *Leptodeira maculata* (Hallowell, 1861) of western Mexico (type locality "Tahiti"); *L. punctata* (Peters, 1866), also of western Mexico (type locality "South Africa"); *Liophis triscalis* (Linnaeus, 1758) of Curaçao (type locality "Indiis"); and *Sibon nebulatus* (Linnaeus, 1758) of Mexico, Central America and northern South America (type locality "Africa").

Other names proposed with no or incorrect locality data have posed lingering problems, especially when nomenclatural stability is threatened, as happens if the biotaxa involved had already acquired names, sometimes much used, of later date. Examples within our personal experience, although not significantly disruptive (i.e., not enough to justify an appeal to the International Commission on Zoological Nomenclature (ICZN) for name-conservation, include *Glauconia boettgeri* Werner (1899), *Eumeces capito* Bocourt (1879), and *Scolecophis fumiceps* Cope (1861). The first was accompanied by no locality data whatever (although subsequent speculation focused on Africa), Bocourt's name by the published data "la côte orientale des Etats-Unis", although its museum registers record "Mexique" and

"Amérique septentrionale", and Cope's name by "probably Cuba." Werner's name ultimately proved to antedate *Leptotyphlops humilis slevini* Klauber (1931) of the Cape region of Baja California; Bocourt's name (Smith, Smith and Guibé, 1941) to antedate *Eumeces xanthi* Günther (1889) of China; and Cope's name (Smith, 1941) to antedate *Tantilla kirnia* Blanchard (1938) of southern Texas and northern Tamaulipas. Since no appeal for name-conservation was considered to be warranted in these cases, the three taxa are now known as *L. h. boettgeri*, *E. capito*, and *T. nigriceps fumiceps*, respectively.

Appeal for conservation was made, successfully, in another case, involving *Henicognathus sumichrasti* Bocourt (1886), supposedly from "Cacopriets" (=Cacoprieto), Oaxaca, Mexico. Guibé and Roux-Estève (1962) showed that the holotype is an example of the long-recognized *Ablabes chinensis* Günther (1889) of China (now *Sibynophis c. chinensis*). Bocourt's earlier name was suppressed, and Günther's name conserved, by the ICZN in 1965.

Generally, however, onomotaxa proposed for type material with incorrect or no locality data prove ultimately to have been applied to biotaxa having been given names previously. Thus such erroneously created names sink into oblivion as junior synonyms, never to be revived unless their senior synonyms are discovered to be invalid for one reason or another (although such jr. synonyms ordinarily are forever invalid, the names are forever occupied and cannot be used later even in a different context, in the same genus). Numerous such cases are known. Werner (1924, 1925) proposed thirteen new snake genera and species based on type material with no or incorrect locality data, all but two of which are now known to be jr. synonyms of earlier names (Wallach, 1988). Other examples include Cope's (1861) *Prymniodon chalceus*, supposedly from "Slam", which proved to be a jr. synonym of *Eutaenia sackenii* Kennicott (1859) (now *Thamnophis sauritus sackenii*; Rossman, 1961) of Florida; and Malnate's (1968) *Natrix durni*, type locality "Kuala Lumpur, Malaysia", is a jr. synonym of *Thamnophis cyrtopsis* (Kennicott, 1860) fide Rossman (in litt.). Müller's (1923) *Cochliophagus tornieri*, from "South America", is a jr. synonym of *Sibon fasciatus* (Günther, 1858) of Mexico, fide Amaral (1929). Similarly, Fischer's (1885) *Leptognathus albocinctus*, from "San Francisco, California", is a jr. synonym (Kofron, 1985) of *Sibon philippi* (Jan, 1863), of western Mexico.

To the list in the preceding paragraph (which could be considerably extended, as could the others) we here add *Boella tenella* Smith and Chiszar (1992), supposedly from Oaxaca, Mexico, but which, as determined initially by VW, actually represents *Epicrates inornatus* (Reinhardt, 1843) of Puerto Rico. For the egregious error HMS assumes full responsibility. Curiously,

fide Schwartz and Thomas (1975), *Boella* is the second jr. synonym acquired by *E. inornatus* based on material with erroneous locality data; the first is *Piesigaster boettgeri* Seoane (1881), supposedly from "Mindanao, Philippine Islands."

In examining the holotype of *Boella tenella* (UCM 56508), VW discovered that numerous major errors of anatomical interpretation appeared in the original description, contributing in part to the incorrect taxonomic conclusions. Contrary to the statements there, the hyoid cornua are divergent (and possibly joined anteriorly), hypapophyses are absent on the posterior vertebrae, and the specimen is a juvenile male. Additionally, there is no tracheal lung, a large left lung is present, and the tracheal entry into both left and right lungs is subterminal. All of these characters demonstrate that the specimen is not a member of the Tropidophiidae but of the Boidae (McDowell, 1987).

Among the Boidae, the specimen can undoubtedly be allocated to *Epicrates*. A visceral structure peculiar to *Epicrates* is the sudden constriction of the left lung, leaving the posterior half greatly reduced in diameter to a thin tail. The left lung of *Boella* exhibits a thin tail along the caudal 52% of its length.

The fact that the specimen is a male is revealed by the presence of an immature testis and paired hemipenes. A peculiarity in the viscera of this specimen is indicated by the apparent presence of only one undeveloped testis (right, 1.1% SVL) and one adrenal gland (right, 2.1 % SVL), both of which are located adjacent to the right kidney (right testis midpoint 73.5%, right adrenal midpoint 74.1%, and right kidney midpoint 74.1% SVL), a most unusual situation for any snake. The gonads and adrenals are located cranial of the kidneys in most snakes although in some species the caudal tip of the left gonad may overlap the cranial tip of the right kidney (Wallach, 1991). In support of the fact that the specimen is a juvenile, the testis is underdeveloped (1% SVL; adult *Epicrates* have testes 3-6% SVL) and an umbilical scar (four ventrals in length) is present. Sheplan and Schwartz in 1974 were not aware of any young of this species in American collections.

Within *Epicrates* the type of *Boella* keys out to be an *Epicrates inornatus* of Puerto Rico (Schwartz and Henderson, 1985). Additionally, all of its scale counts (except subcaudals, which lower the range for the species by one) fall within the range of variation of *E. inornatus* as reported by Sheplan and Schwartz (1974). Following are the counts of *Boella* with the ranges reported by Sheplan and Schwartz for *E. inornatus* (male counts only for ventrals and subcaudals) given in parenthesis: ventrals, 264 (263-273); subcaudals, 65 (66-74); ventrals plus subcaudals, 329 (329-338); anterior

scale rows, 33 (31-34); midbody scale rows, 39 (38-42); posterior scale rows, 21 (21-25); supralabials, 11-12 (11-12); supralabials entering orbit, 6-7 (5-7); infralabials, 12-13 (11-15); loreals, 2 (1-2); circumorbitals, 8-9 (7-10); pre-intersupraoculars, 2 (2-3); intersupraoculars, 1 (1); and post-intersupraoculars, 2 (2-3). Stejneger's (1904) figure of the head scales of a young specimen (USNM 12446) is very similar to the *Boella* type. The greatest peculiarity of the latter is the fusion of internasals and nasals; the combined scales were interpreted as nasals in contact medially by Smith and Chiszar (1992), a condition apparently not recorded previously in *Epicrates*. That interpretation is presumably untenable, the nasals being fused anomalously with the internasals.

A comparison of the internal anatomy of *Boella* with that of a subadult female (770 mm SVL) *Epicrates inornatus* (UMMZ 74415) reveals a remarkable agreement in morphology, placement, and size of the viscera, especially when considering normal ontogenetic and sexual variation (Wallach, 1991). Following are the visceral data, expressed as % snout-vent length (SVL) unless otherwise indicated, for *Boella* and (parenthetically) *Epicrates inornatus*: posterior tips of hyoid, 6.5 (5.2); trachea plus intrapulmonary bronchus length, 32.2 (32.0); trachea plus intrapulmonary bronchus midpoint, 16.1 (16.0); approximate number of tracheal rings, 419 (434); width of tracheal membrane/width of tracheal rings, 0.3 (0.2); heart length, 2.3 (2.6); heart midpoint, 27.3 (27.9); junction of systemic arches, 29.9 (29.2); orifice of right lung (midpoint), 29.5 (29.9); cartilages in right intrapulmonary bronchus, 5 (11); right lung length, 28.9 (30.3); right lung midpoint, 41.6 (44.0); right lung posterior tip, 56.1 (59.1); left lung length, 19.3 (19.5); left lung midpoint, 37.2 (38.8); left lung posterior tip, 46.9 (48.6); left lung/right lung, 66.7 (64.4); heart-liver gap, 8.4 (6.8); liver length, 17.6 (18.7); liver midpoint, 45.6 (45.3); liver-gall bladder gap, 7.3 (6.8); liver-gall bladder interval, 26.8 (27.1); gall bladder midpoint, 62.7 (62.3); right kidney length, 3.4 (3.6); right kidney midpoint, 74.1 (77.5); number of right kidney lobes 10(10); number of right renal arteries 2 (1); left kidney length, 3.6 (3.4); left kidney midpoint, 80.7 (81.8); number of left kidney lobes 8 (9); number of left renal arteries 1 (1); right plus left kidney length, 6.9 (7.0); kidney-vent interval, 27.6 (24.3); kidney-vent gap, 17.6 (16.5); and umbilical scar-anal plate interval in % ventrals, 30.7 (31.2).

The differences evident in the preceding comparisons are not significant, and indeed are smaller than might be expected. There can be no doubt as to the correct identity of *Boella tenella*. We therefore remove *Boella* from the family Tropidophiidae and place *Boella tenella* in the synonymy of *Epicrates inornatus* (Reinhardt, 1843), family Boidae.

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STRIPED PRAIRIE KINGSNAKES, *LAMPROPELTIS CALLIGASTER*. FROM ILLINOIS

The occurrence of aberrant color patterns in snakes is relatively common, descriptions of such are found throughout the literature (reviewed by Bechtel 1978). More specifically, striping has been found in a number of snake taxa. For example, Gloyd (1958) described abnormal striping in *Crotalus scutulatus* and *Crotalus horridus*. This report represents the second published account of striping in *Lampropeltis calligaster*. Ashton (1973) described a single striped individual that hatched from a clutch of 13 eggs, all other siblings were normally patterned.

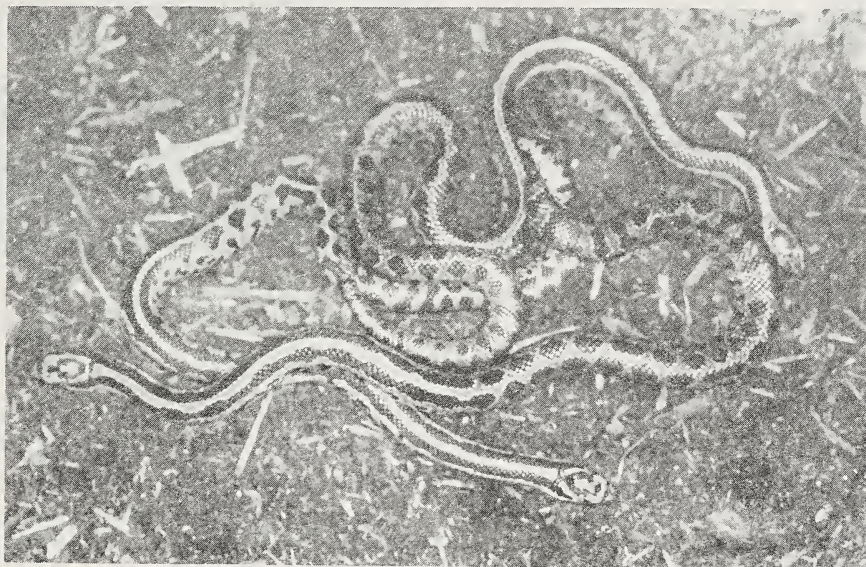
In April of 1991 in Effingham County a normally patterned adult female *L. calligaster* (SVL=790 mm) was captured. On June 15, 1991 the female laid 10 normal sized eggs, two eggs were infertile and were later discarded. The eggs were incubated on damp vermiculite at 24-28° C. On August 13, 1991 six of the eight remaining eggs hatched. Five of the six hatchlings showed various degrees of striping (Table 1). One of the striped hatchlings (hatchling 6 in table 1) had a severe "kink" approximately two head lengths behind the neck and died 36 days after hatching. The remaining two eggs were opened August 15 and each contained a fully developed snake. One had severe bone deformations and was striped and the other appeared normal though small and was normally patterned.

Table 1 shows snout-vent length, stripe length, the percent snout-vent length of striping, and the width of striping in terms of the number of dorsal scales covered. The range of the percent striping was 7.4% - 70.0% of the snout-vent length with a mean percent of striping of 42.1% and standard deviation 25.9%.

While working on another project, I discovered a specimen of *L. calligaster* from Osage County Oklahoma with a continuous mid-dorsal stripe in the collection of the Museum of Natural History at the University of Kansas (KU 154482). The stripe covered 1.5 to 2.5 dorsal scales. The snake had a snout-vent length of 497 mm and a stripe length of 510 mm.

Table 1. Stripe length is shown as a percentage of actual stripe length to snout-vent length. Stripe width is shown in terms of the number of dorsal scales covered. Individual 6 survived for only 36 days, individuals 7 and 8 were fully formed snakes that did not hatch.

Hatchling	SVL	Stripe Length	% SVL Stripe Length	Stripe Width in Number of Dorsal Scales
1	295 mm	90 mm	30.5 %	2-3
2	270	20	7.4	3-4
3	305	190	62.3	2-3
4	275	125	45.5	2
5	320	40	12.5	2
6	200	140	70.0	2
7	180	120	66.7	2-3
8	180	Normal pattern		



Photograph by Gary Paukstis

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—J. Scott Keogh, Department of Biological Sciences, Illinois State University,
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NOTES

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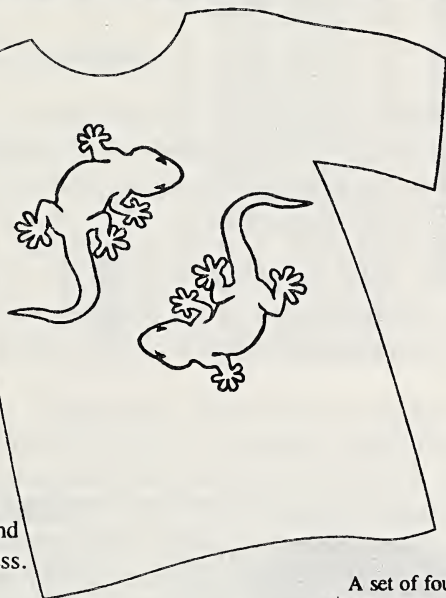
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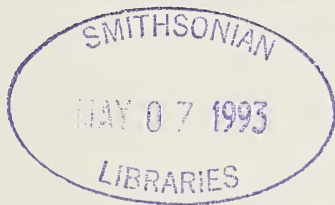
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31 MARCH 1993

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Volume 29 Number 1

March 1993

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The Maryland Herpetological Society
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The third Wednesday of each month, 8:15 p.m. at the Natural History Society of Maryland (except May—August, third Saturday of each month, 8:00 a.m.). The Department of Herpetology meets informally on all other Wednesday evenings at the NHSM at 8:00 p.m.

NEW VARIATIONAL EXTREMES FOR *TANTILLA CALAMARINA* AND A LOCALITY RECORD CORRECTION FOR *CONOPHIS VITTATUS VIDUUS* (REPTILIA: SERPENTES)

Hobart M. Smith, Oscar Flores Villela and David Chiszar

A juvenile female *Tantilla calamarina* Cope (MZFC-UNAM (Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México) 809) from near El Platanito, on the Tepic-Jalcocotán highway in Nayarit, Mexico, municipality of Tepic, exhibits variational extremes not previously recorded for the species in the exhaustive reviews by Wilson and Meyer (1981) and Wilson (1988). The specimen is only 77 mm in total length (tail 8 mm), shorter than any of 22 females of the species recorded by Wilson and Meyer (1981), with a range of 104-202 mm. Its condition is very good, the body nearly straight but the neck sharply bent to the right at a 180° angle, leaving the head parallel with the neck.

Most character states conform with the norms for the species (Wilson and Meyer, 1981): six supralabials, the fifth separated from parietal; postoculars and preoculars 1-1, the latter in contact with postseminasal; first infralabials separated; 129 ventrals. There are, however, only 22 subcaudals (vs 25-33 previously recorded). The pattern on the head is the same as described and illustrated by Wilson and Meyer (1981), but the pattern on body is more elaborate than previously described. The usual vertebral dark line is present, although narrow and confined to the median third or less of the median scale row, and the typical broad dark stripe occupies the adjacent parts of the 3rd and 4th scale rows, more extensive on the former. However, all other scale rows, except the 7th on each side, have a continuous, narrow, median dark line, lighter than the three primary lines, but still very distinct. All lines extend from neck to tail, except for the one on the 6th scale row, which from about midbody to tail is represented by a series of dim dark spots. Only the primary dark lines continue onto the tail. The secondary lines constitute merely an enhancement of the separate dark streaks on most scales, as shown in Fig. 2 of Wilson and Meyer (1981), although the result is strikingly distinctive.

Because of the many basic similarities to other examples of the species, and the numerous records for the same area whence the present specimen came, there is no reason to suspect that the latter represents anything but a variant of *T. calamarina*.

This specimen was previously reported (Flores et al., 1991: 182) erroneously as *Geagras redimitus* Cope, which is actually limited, so far as known at present, to Oaxaca (state) (Wilson, 1987). This is not the only occasion on which these two closely similar species have been confused, as noted by Wilson and Meyer (1981: 21), who called attention to a record of *G. redimitus* from Michoacán that in fact pertains to *T. calamarina*.

We take this opportunity to correct an erroneous record (Flores et al., 1991: 177) of *Conophis vittatus viduus* Cope for Mérida, Yucatán, Mexico, to *Coniophanes imperialis clavatus* (Peters). The specimen in question (MZFC-UNAM 3170) is typical of its taxon, having 19-17 scale rows; 125 ventrals; 77 subcaudals; a light, dark-edged line through upper part of eye; a dark line through upper part of supralabials, which are immaculate white below that line; a continuous, narrow, vertebral dark line; sides of body dark below a dark line along middle of 4th scale row; lateral edges of ventrals with a small, irregular dark spot. These character-states agree fully with the ranges of variation summarized by Bailey (1939: 35-41). Although the latter author had seen no specimens from Yucatán, many were available for Lee's (1980: 65) review. The present specimen thus constitutes no range extension or morphological variation not previously recorded.

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**PHYLOGENETIC RELATIONSHIPS AND TAXONOMY OF
COLOSTETHUS MANDELORUM (ANURA: DENDROBATIDAE),
WITH NOTES ON COLORATION, NATURAL HISTORY, AND
DESCRIPTION OF THE TADPOLE**

Enrique La Marca

In this paper, the Neotropical frog *Colostethus mandelorum* is redescribed, and new data on measurements, coloration in life and in preservative, and natural history is added to the knowledge on the species. The tadpole of the species is also described for the first time, and a discussion of phylogenetic relationships is provided.

En este trabajo se redescrive la rana neotropical *Colostethus mandelorum*, y se complementa el conocimiento sobre la especie con datos nuevos sobre medidas morfométricas, coloración en vida y en preservativo, e historia natural. También se describe por vez primera el renacuajo de la especie, y se ofrece una discusión sobre sus relaciones filogenéticas.

Among the thirty-two frogs collected by E. R. Blake during the 1932 Mandel Expedition to northeastern Venezuela, there were two specimens secured in the mountain known as Cerro Turimiquire (or Turumiquire). They were described by Karl P. Schmidt (1932) as a new species, although unfortunately leaving aside a large series of conspecific frogs discovered two years earlier in the same mountain by M. G. Netting. The new form, *Phyllobates mandelorum*, was differentiated from *P. trinitatis* Garman, the geographically nearest congener, on the basis of its dorsal and ventral coloration (Schmidt, 1932: 160). The name was apparently used only once in the literature (Ginés, 1959) until it was assigned to the genus *Prostherapis* and considered a subspecies of *P. trinitatis* by Rivero (1961: 160). Rivero did not give reasons for usage of the trinomen, but from his "remarks" on the species it could be inferred that the decision resulted from comparing the holotype of *Phyllobates mandelorum* with syntypes of *P. trinitatus* (presumably those in the Museum of Comparative Zoology at Harvard), and noting that they had a "striking similarity" (a similarity that he expected on the basis of close proximity to the type-locality of *P. t. trinitatis*; Rivero, 1961: 161). Since then, the trinomen has been used several times in the literature. Although the name *Prostherapis mandelorum* was used by Dononso-Barros (1966), and *Colostethus mandelorum* (current generic allocation) by Edwards (1971), neither author gave reasons for returning to the binomen. Working

independently, several authors (Hardy, 1984: 109; La Marca, 1984: 245; Rivero, 1984: 10) discussed the distinctiveness of the species previously suggested by Edwards (1971).

In spite of the general agreement about the validity of the species, the systematic relationships of *Colostethus mandelorum* are not clear. Thus, Rivero (1984: 12) considered that *C. mandelorum* most probably had derived from an ancestral stock of *C. trinitatis*, a position later sustained when he (Rivero, 1990: 23-24) indicated the possibility that the species is "un derivado de las especies acollaradas." This consideration notwithstanding, he did not assign the species to any of his later (Rivero, 1990) species groups.

Examination of the holotype and paratype of *Colostethus mandelorum* (Schmidt), along with twenty-two additional specimens, made clear that, although *C. mandelorum* is a distinct species, its relationships are not to be found among the collared frogs with whom they have been repeatedly related (La Marca, 1984: 245, "ms.3"; see below). These results, along with other data on the species so far unpublished, prompted me to write this paper in the hope that it will contribute to the current taxonomic and systematic knowledge on the species. A detailed description of the holotype is provided to complement two short available descriptions (the original by Schmidt, 1932; and that of Rivero, 1961, that largely duplicates the original).

The format, methods, and terminology, as well as pertinent *Colostethus* material examined in association with this study, are found in La Marca (1984). Staging of tadpoles was performed according to the methods of Gosner (1960). Specimens of *C. mandelorum* examined for this study are : FMNH (Field Museum of Natural History) 17788, male, holotype, 17789, male, paratype, Estado Sucre, Mount Turumiquire, 8000 ft.; ANSP (Academy of Natural Sciences of Philadelphia) 25757, female, Estado Sucre, Mount Turumiquire; CM (Carnegie Museum of Natural History) 9132 - 9135, 9137, 9140, 9152 - 9154, 9158 - 9165, 9167, 9174, 9176 - 9177, (5 males, 14 females, 3 juveniles), 9172 (tadpoles), Estado Sucre, Elvecia.

Colostethus mandelorum (Schmidt)

Phyllobates mandelorum Schmidt, 1932: 160.

Prostherapis trinitatis mandelorum, Rivero, 1961: 160.

Prostherapis mandelorum, Donoso-Barros, 1966: 29.

Colostethus mandelorum, Edwards, 1971: 148; Hardy, 1984: 109; La Marca,

1984: 245; Rivero, 1984: 10; Frost, 1985: 91; Rivero, 1990: 23; La Marca, 1992a: 27.

Description of the holotype (with notes on intraspecific variation given within parentheses). -Head as long as wide; top of head smooth, interorbital area convex; interorbital distance about 2 times greater than upper eyelid width; canthus rostralis not well defined; nostrils directed laterally, not elevated (slightly elevated in paratype FMNH 17789); nostrils closer to tip of snout than to eye; loreal region almost flat, sloping abruptly to lip; snout subelliptical in dorsal view; tip of snout broadly rounded in dorsal view (almost truncate in several specimens; e.g. Fig. 2); tip of snout rounded in lateral profile; length of eye greater than eye to nostril distance; internarial distance greater than eye to nostril distance; tympanum about $\frac{1}{3}$ the length of eye, somewhat inconspicuous, with only anterior and ventral parts visible; tympanum separated from eye about $\frac{2}{3}$ its horizontal length; no supratympanic fold; a single tubercle at rictus, no post-rictal tubercles; tongue piriform, longer than wide, with posterior end deeply notched (entire in paratype FMNH 17789); posterior $\frac{1}{3}$ of tongue not adherent to floor of mouth; choanae rounded, not concealed by palatal shelf of maxillary arch (partially concealed in most female samples); maxilla and premaxilla toothed, teeth pedicellate and short.

Dorsum smooth (some specimens bear scattered small tubercles, more conspicuous on lower back); flanks smooth (tuberculate in several specimens); throat, chest and venter smooth; brachium tuberculate, antebrachium smooth; no ulnar fold or row of tubercles; palmar tubercle single, subtriangular (broadly rounded in paratype FMNH 17789) in outline, about 4 times size of thenar; thenar tubercle elongated, about 1.5 times longer than wide, elevated; no supernumerary tubercles; subarticular tubercles moderate-sized, flattened, ovalate; small pads on fingers; largest pad on third finger, almost covering the tympanum when placed on it; pads wider than long; pad on third finger about 1.6 times wider than adjacent phalanx; second and third finger inconspicuously keeled (Fig. 1), first finger shorter than second; third finger not swollen.

Cloacal opening slightly above midlevel of thighs, directed posteroventrally; very short cloacal fold with scalloped free margin; thighs, shanks and tarsi tuberculate above, smooth below; tarsal fold well-defined, not ending in tubercle, extending from the base of the inner metatarsal tubercle obliquely across ventral side of tarsus to the median line; tarsal fold connected with outer lateral flap of inner toe; outer metatarsal tubercle rounded, subconical in lateral profile; inner metatarsal tubercle oval, about twice longer than wide, and about twice as large as the outer metatarsal tubercle; no supernumerary tubercles; subarticular tubercles small, rounded

to oval, flattened; toes moderately webbed; web of the holotype matches the low values of the formula for the series studied, which follows: I (1.0-1.5)-(0.5-1.0) II (1.0-1.5)-(0.5-1.0) III (1.0-1.5)-(1.0-1.5) IV (0.5-1.0)-(1.0-2.0) V [higher values correspond mostly to *Elvecia* specimens, although at least one specimen from the type locality, ANSP 25757, possesses a web development similar to the *Elvecia* sample]; toes with flap-like lateral fringes; a lateral keel running from near the outer metatarsal tubercle (or near the mid metatarsus in most specimens) to base of fifth toe, where it meets the outer lateral fringe on that toe; pads slightly wider than long; largest pad on fourth toe, slightly larger than pad on third finger and about 1.7 times wider than adjacent phalanx (Fig. 1); when thighs are held at right angles to body axis, heels slightly overlap as in other males (in females, either they do not overlap or just touch each other); heels reaching to posterior corner of eye when legs are adpressed forward.

Measurements of holotype (in mm, abbreviations as in Table 1). –SVL 25.8, IN 3.3, HW 9.2, TL 11.5, EN 2.0, HAND 7.6, FOOT 11.5, EYE 3.5, testes 3.0. Measurements and proportions for other *Colostethus mandelorum* (including the holotype) are given in Table 1.

Coloration in preservative. (Fig. 2) Dorsum pale cream with dark brown sinuous paravertebral markings (those of the holotype can be best described as an inverted triangle encompassing both upper eyelids, with base toward anterior part, connected with an irregular diamond-shaped marking in shoulders having pale spots inside, and continuing on posterior part with irregular brown markings with ill-defined borders. Brown markings stopping at level of inguinal region, where two dorsal pale bands of background coalesce to form a narrow band on the end of urostyle); dark brown dorsolateral stripe extending from anterior border of eye to inguinal region (some specimens, including the holotype, have the top of anterior part of head pale cream with a brown spot just in front of an imaginary line connecting anterior ends of upper eyelids); specimens from *Elvecia*, agreeing largely in morphology with the holotype, have a larger amount of variation in their pattern of dorsal spots than do topotypes (juvenile CM 9140, from *Elvecia*, however, have similar dorsal pattern to that of the holotype); a pale stripe may run (interrupted or not) from insertion of one upper arm to insertion of the other, surrounding the head; dark canthal stripe surrounding snout and encompassing nostrils; lower lip dusted with brown; dark stripe running on upper lip, sometimes presenting a medial bump on loreal region; tympanum paler than surroundings; a dark longitudinal band on anterior part of upper arm; discrete pale inguinal stripe (occasionally only a series on non-connected pale spots) usually running from inguinal region to point where elbow reaches when adpressed backwards on flank; borders of anal opening pale, sometimes with small pale spots below; dark brown longitudinal

stripe on anterior part of thigh; diffuse cross-barrings on thighs, shanks and tarsi (cross-bar markings are more conspicuous in juveniles); concealed parts of tarsi dark, with a pale tarsal fold; adult females with marbled throat, chest and upper venter, and pale cream lower venter; adult males with brownish ventral surfaces where dark brown specks are less conspicuous than, and pale spots smaller than in females; two brown spots on throat, below chin; collar absent; palms and soles darker than other ventral surfaces.

Coloration in life.— Schmidt (1932: 160) reported a greenish silvery dorsum and top of the head for the holotype. Other notes on coloration, used for the following color description, are found in Netting's field notes of January 1930. In these notes, several dorsal color patterns for individuals of *C. mandelorum* were reported: olive green, bronze, greenish, dark greenish gray, and bright greenish bronze. Flanks were described as greenish, gray green or olive greenish; the inguinal stripe as pale yellow; throat and chest as yellowish, gray, yellow white or pale bluish white; chin orange or pinkish; markings on chin as bluish white; markings on throat and venter were noted as brown, bluish white, red or reddish brown; venter as pale green, greenish yellow, bright yellow, yellow orange, pale yellow or greenish; upper legs were indicated as brown, and the under legs as pale brown, dull orange, light green or orange; under arms are more orange than yellow; a touch of yellowish at leg insertions, and toe pads were gray.

Natural history.— Almost nothing is known on the natural history of *Colostethus mandelorum*, although a few aspects can be drawn from the available field notes and the localities where they have been taken. Thus, from one of the places (Elvecia, Edo. Sucre) is known that the species occurred in small pools along mountain streams, where they dived and rested on the bottom when they were frightened (Netting, field notes January 1930). From the sample available for study, it can be inferred that males may reach sexual maturity at a size of at least 22.6 mm, and females at 24.0 mm, judged from the enlarged testes and vocal slits, and deeply convoluted oviducts and/or mature ova, respectively. Stomachal contents revealed the presence of the following prey items: ants (adult male CM 9135), Coleoptera (adult females CM 9137 and 9159), and both ants and Coleoptera (adult female CM 9132).

Some ecological aspects of the habitat of *Colostethus mandelorum* may be extrapolated from the places where the species has been collected. Those places lie within the "Macizo del Turimiquire", an orogenic feature holding at least four life zones. These, in the classification of Ewel et al. (1976) are: premontane humid forest ("bosque húmedo premontano", bh-P), premontane very humid forest ("bosque muy húmedo premontano",

bmh-P), lower montane very humid forest ("bosque muy húmedo montano bajo", bmh-MB), and lower montane humid forest ("bosque húmedo montano bajo", bh-MB). The mean annual temperatures of these environments range from 11 to 24° C, with a mean annual precipitation of 1000 to 4000 mm, and an altitudinal range covering from 500 to 2600 m. Our only datum of altitude for the species is "8000 ft." (about 2440 m), corresponding to the type specimen. Only two of the mentioned life zones match this elevation, bmh-MB and bh-MB. These ecosystems are immediately above the premontane forests, separated from them by the "critical" temperature (Ewel et al., 1976) of 18° C, a value that seems to be of paramount importance for different species. Thus, for example, coffee plantations grow best in premontane forests, being almost absent in lower montane ones. On the contrary, autochthonous conifers (*Podocarpus* spp.) and introduced grasses (like the "Kikuyo" grass, *Pennisetum clandestinum*) grow best in lower montane forest. This "critical" temperature appears to affect frogs in a similar manner; species of *Mannophryne* prosper in premontane forests (La Marca, 1992b), while those of the *Colostethus alboguttatus* group are abundant in lower montane forests. In this regard, *Colostethus mandelorum* may occupy habitats similar to those inhabited by the species of the *C. alboguttatus* group, while its purported relative, *Colostethus* (= *Mannophryne*) *trinitatis*, lives in premontane forest; that is, the "critical" temperature of 18° C may be separating the distributional ranges of both species. This hypothesis needs to be tested when more material and data become available. For the moment, considering the evidence, it seems safe to state that *Mannophryne* inhabit places with a mean annual temperature between 18 and 24° C, while species in the *C. alboguttatus* group, as well as *Colostethus mandelorum*, live in places with temperatures between 18 and 11° C. In both cases, a minimum of 1000 mm of mean annual precipitation seems to be germane. These environmental parameters may constitute useful cues of prospective places where to look for these frogs.

Tadpole.— Nineteen larvae (CM 9172) collected at Elvecia, Estado Sucre, are referred to *Colostethus mandelorum*. This allocation is tentative because no tadpoles carried on dorsa were available for examination. No other dendrobatid frog is known to occur sympatrically with *C. mandelorum*, although *Mannophryne trinitatis* occurs at lower elevations than *C. mandelorum* on Cerro Turimiquire. The tadpoles from Elvecia differ from those of *Colostethus* (= *Mannophryne*) *trinitatis* reported by Kenny (1969) in having the first upper row of denticles completely keratinized, with equal-sized denticles.

Description of tadpoles.— Body oval in dorsal view, depressed (wider than deep), deepest and widest at about two thirds length of body (from tip of snout to body-tail juncture); tip of snout broadly rounded; lateral line

organs appearing as pale dots arising near the mouth, crossing mid-loreal region to surround posterior part of eye and return again to tip of snout, running parallel to an imaginary line connecting eye and nostril. Another line of pale dots originating posteriorly to eye, bifurcating into dorsolateral and vertical lines. the latter splits into two branches (just above and anterior to spiracle, on left side), one directed vertically, surrounding base of head, and another running oblique to middle of caudal musculature; nostrils dorsolateral, directed anterolaterally, rounded with pale borders, slightly closer to eye than to tip of snout; internarial distance wider than interorbital distance; chondrocranial elements not visible through skin of head; spiracle sinistral, forming a tube attached to body wall; spiracular opening directed posterodorsally at about midlength of body and at about 40% distance from bottom to top of body; cloacal tube short, with dextral opening; dorsal fin arising at body-tail juncture or anteriorly; caudal fins about equal in depth; fins shallower than caudal musculature at midtail length; caudal musculature moderately strong, tapering gradually to end just short of tip of tail; tip of tail rounded (Fig. 3, top).

Mouth relatively small, situated ventrally at tip of snout, directed anteroventrally; mouth with moderately developed lateral folds; a single row of alternating marginal papillae, except for anterior diastema on upper lip; single row of alternating papillae at corners of lower lip; beaks strong, well keratinized only near cutting edge, bases not keratinized; lower beak with stronger dentition than upper beak; blunt serrations on both beaks; upper beak with narrow lateral extensions; lower beak broadly V-shaped; two upper and three lower rows of denticles; upper rows of same length, arched outward medially; first upper row complete, second upper row widely separated medially; lower rows complete, equal-sized, about equal in length to upper rows; denticles on third row smaller and less keratinized than those on other rows (Fig. 3, bottom).

Tadpole coloration.— In preservative, dorsum, flanks and venter uniformly dark brown; caudal musculature paler than body; caudal fins cream, dusted brownish, with large dark brown flecks. Coloration in life unknown.

Measurements of tadpoles (in mm \pm standard deviation).— Stage 25 (N=8), body length = 8.84 ± 0.5 ; total length = 20.9 ± 1.1 . Stage 26 (N=5); body length = 9.84 ± 0.4 ; total length = 23.9 ± 2.1 . Stage 27 (N=6); body length = 11.75 ± 0.5 ; total length = 29.9 ± 1.5 .

Discussion.— *Colostethus mandelorum* has usually been associated with a collared frog (*Mannophryne trinitatis*) owing to aspects of the ventral

and dorsal coloration already pointed out by Schmidt (1932: 160). Throat and chest of male holotype and paratype are dark, covered by melanophores, although not as black as in sexually matured male collared frogs (*Mannophryne*). I regard this condition as different from that exhibited by collared frogs, and therefore I consider *Colostethus mandelorum* as lacking a "true" collar. The absence of a collar in *C. mandelorum* is a non-informative character, but the combination of patterns of dorsal color, dark dorsolateral bands, and ventral and gular melanophores may indicate that the species is not closely related to any of the species of *Mannophryne*. The gular pattern of melanophores in *C. mandelorum* reminds the condition seen in members of the *C. alboguttatus* group. This group, designated by La Marca (1985), is diagnosed based on a dentition characterized by the presence of long maxillary and pre-maxillary teeth ("Fang-like" teeth of La Marca, 1984: 245, "ms. 1"). The same character is also exhibited by the monotypic *Aromobates* Myers et al. (1991). Although its relationships to the *Colostethus alboguttatus* group can not be ascertained at present, *Aromobates nocturnus* is most similar to some species in this assemblage (like, for e.g., *Colostethus leopardalis*). Although *Aromobates* has a smell that is not present in members of the *C. alboguttatus* group (probably an apomorphic character), I consider this species to be more closely related to this group. Further studies may even reveal that them all are congeneric. *Colostethus mandelorum* lacks long teeth, making proper allocation difficult. Characters of *C. mandelorum* resembling those present in members of the *C. alboguttatus* group may be plesiomorphic and the species may be either completely unrelated, or a relatively primitive member of that assemblage.

Colostethus mandelorum is readily distinguished from species within *Mannophryne* and within the *C. alboguttatus* group by the absence of a dark collar, and by the presence of small teeth, respectively. The combination of dorsal pattern of coloration, dark dorsolateral stripes and distribution of melanophores on throat and venter resembles that seen in some members of the *C. alboguttatus* group but, without knowing the degree of apomorphy of these characters, allocation of *C. mandelorum* to this group would be unfounded. The presence of lateral fringes along the second and third fingers (Fig. 1) is shared, among other Venezuelan Andean and coastal range *Colostethus*, only with *C. dunni* (Rivero) and *C. leopardalis* Rivero. *Colostethus dunni* possesses an extensive foot web and different dorsal pattern, and neither *C. dunni* nor *C. leopardalis* have dorsolateral stripes. Furthermore, the upper beak in the Elvecia tadpoles has a median convexity resembling that present in some members of the *C. alboguttatus* group (e.g. *Colostethus mayorgai*, see La Marca and Mijares, 1988: 49). Other traits such as the position of the spiracle, and the type of serration on beaks are also more similar to those shown by members of the *C. alboguttatus* group. Lack of

knowledge on the distribution of these features among dendrobatids precludes inferences about its importance in determining phylogenetic relationships.

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Table 1.

Measurements and proportions of *Colostethus mandelorum*. Abbreviations as follows: SVL = snout to vent length, IN = intermarial distance, HW = head width, TL = tibia length, EN = eye to nostril distance, Tymp = horizontal length of tympanum. All measurements in mm. Mean \pm 1 S. E. is given above. Range and sample (in parentheses), below.

	SVL	IN	HW	TL	EN	HAND	FOOT	EYE	TYMP
Male	24.1 \pm 1.3	3.1 \pm 0.1	8.2 \pm 0.6	11.3 \pm 0.3	1.9 \pm 0.1	7.3 \pm 0.3	11.4 \pm 0.4	3.3 \pm 0.2	1.2 \pm 0.1
	22.6-25.8 (7)	2.9-3.3 (6)	7.6-9.2 (5)	11.0-11.7 (6)	1.9-2.0 (6)	6.8-7.6 (6)	10.8-11.9 (6)	3.1-3.6 (6)	1.1-1.3 (3)
Female	26.7 \pm 1.5	3.4 \pm 0.1	9.0 \pm 0.4	12.3 \pm 0.5	2.1 \pm 0.1	8.0 \pm 0.3	12.5 \pm 0.4	3.6 \pm 0.2	1.3 \pm 0.1
	24.0-28.8 (12)	3.1-3.7 (10)	8.3-9.6 (12)	11.4-12.9 (12)	1.9-2.3 (10)	7.4-8.4 (9)	11.8-13.1 (10)	3.3-4.0 (10)	1.0-1.4 (8)
<hr/>									
	EN/IN	HW/SVL	TL/SVL	HAND/SVL	FOOT/SVL	TYMP/EYE			
Male	0.63 \pm 0.03	0.34 \pm 0.01	0.44 \pm 0.05	0.30 \pm 0.01	0.47 \pm 0.02	0.38 \pm 0.03			
	0.61-0.66 (6)	0.32-0.36 (5)	0.34-0.48 (6)	0.29-0.31 (6)	0.45-0.51 (6)	0.35-0.42 (3)			
Female	0.63 \pm 0.04	0.34 \pm 0.01	0.46 \pm 0.02	0.30 \pm 0.02	0.46 \pm 0.03	0.36 \pm 0.04			
	0.57-0.70 (10)	0.31-0.35 (12)	0.43-0.50 (12)	0.26-0.32 (9)	0.42-0.50 (10)	0.28-0.40 (8)			

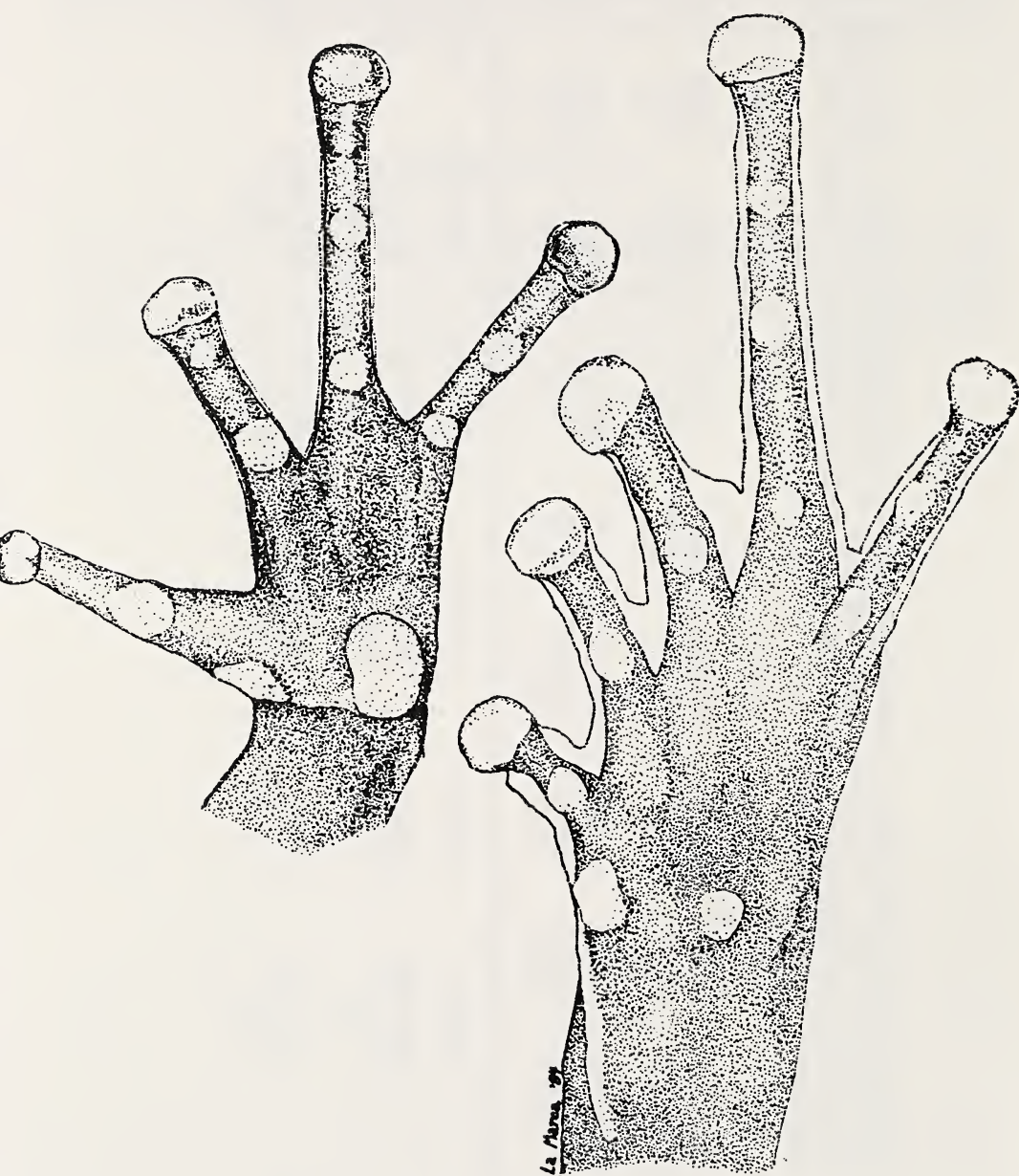


Fig.1 Left: Hand of *Colostethus mandelorum*, CM 9162. Right: foot of *C. mandelorum*, CM 9135. Scale equals 5 mm.

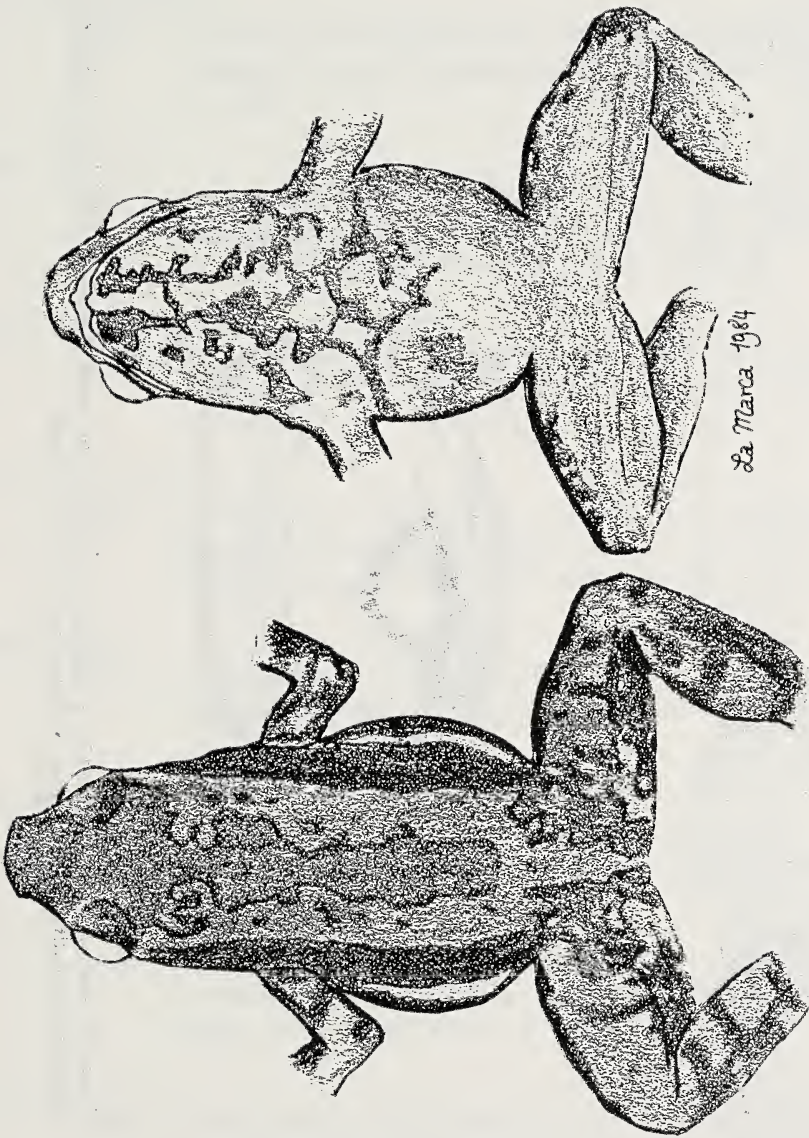


Fig. 2. Dorsal and ventral view of *Colostethus mandelorum*. Left = CM 9174, female, SVL 27.9 mm. Right = CM 9176, female, SVL 24.0 mm.

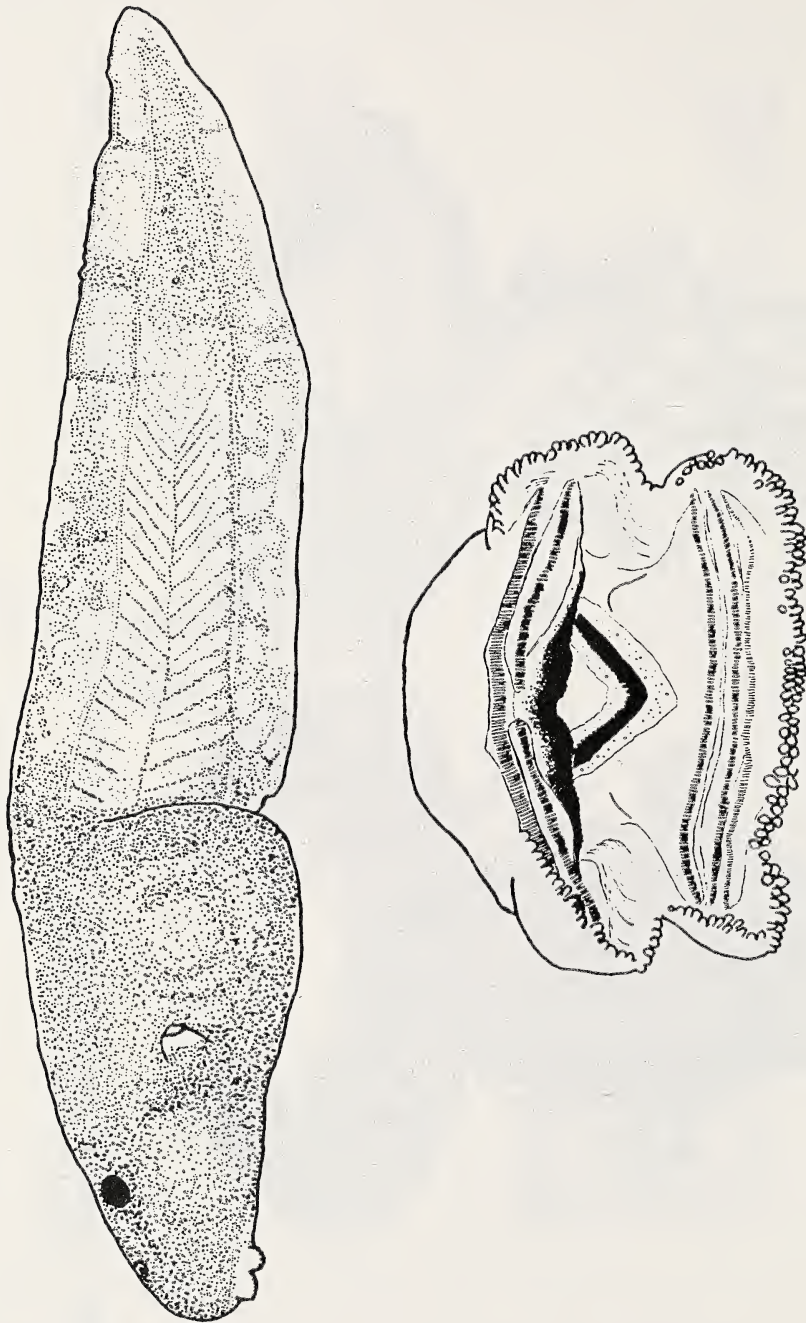


Fig. 3. Lateral view and mouth parts of a tadpole of *Colostethus mandelorum* (CM 9172) in stage 27. Horizontal scale equals 5 mm. Vertical scale equals 1 mm.

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VARIATION IN TWO SPECIES (*G. BICOLOR*, *G. DUELLMANI*) OF MEXICAN EARTH SNAKES (*GEOPHIS*)

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Geophis bicolor is recorded from the state of México, and for the first time from the state of Michoacán, with variations that leave in question the separability of that taxon from *G. chalybeus*. The second and third males of *G. duellmani* are recorded with their variations.

Among the specimens of *Geophis* in the Museo de Zoología of the Facultad de Ciencias (MZFC) of the Universidad Nacional Autónoma de México are four specimens that extend knowledge of the distribution and variation of their two species.

Geophis bicolor Günther

Two males are present, one from near the central southern border of the state of México, municipality of Tenancingo, Salto de Agua near Santa Ana (MZFC 41), the other (MZFC 835) from the state of Michoacán, municipality of Zitácuaro, 0.5 km SSE San Francisco de Coatepec. The former was previously reported by Lara and Flores (1980: 371), although without description, and the latter is the first known from Michoacán.

Respectively, the ventrals are 156, 158; caudals 51, 47; total ventral-caudals, 207, 205; scale rows 17, 17; s-v 189, 103 mm; tail 52, 22 mm; total length 241, 125 mm. In MZFC 41, the postoculars are 1-1, an anterior temporal is present on one side (separating parietal from 5th supralabial), and the two prefrontals are half fused. MZFC 835 has a tiny, lower postocular on one side, and the other side is damaged, the number of postoculars indeterminate, although if a lower postocular is present on that side it is tiny, like the other, because a very large, single postocular is evident as on the intact side above the position where a tiny lower postocular may have been before the head was damaged.

The dorsum in both specimens is uniform dark brown except for light centers on the lower 2-4 rows of dorsals. The venter is unpigmented, and in MZFC 41 the subcaudal surface is irregularly pigmented.

Downs (1967: 56) noted one other specimen with an anterior temporal on one side, but no other with any fusion of the prefrontals, and none with only 1-1 postoculars or with such a tiny lower postocular.

Indeed, presence of two postoculars is one of the few distinctions of *G. bicolor* from *G. chalybeus*, as determined by Downs (1967: 55-59). Data are available only for three of the latter taxon, however, all from Mirador, Veracruz, and for 16 *G. bicolor* (eight in Downs, 1967, and eight in Dixon, 1968), all from either Jalisco or "neighborhood of Mexico City," the latter of which we regard as erroneous (although Downs, 1967: 57 argued for its validity). All previously recorded *G. bicolor* have two postoculars except on one side of two, with one (Dixon, 1968: 453), and all have extensive ventral pigmentation except for those from "neighborhood of Mexico City." The present two specimens, from localities intermediate between Jalisco (*G. bicolor*) and Veracruz (*G. chalybeus*), resemble the latter species more than the former in having the venter essentially immaculate (as do those supposedly from near Mexico city), and in having 1-1 postoculars or only a tiny lower postocular in addition to a large upper one.

The only apparent distinction remaining between *G. bicolor* and *G. chalybeus*, as interpreted by Downs (1967), is the lower ventral count in females (the only sex yet recorded) of the latter (154-155 vs 161-168) and its generally lower ventral plus caudal count (192-196 vs. 195-209). Other apparent differences evident in comparing Downs' two descriptions (1967: 55-59) are not borne out by Dixon's (1968) detailed description of Jalisco specimens, or by our own material.

It is therefore distinctly possible that *G. bicolor* Günther, 1868, is a synonym or geographic race of *G. chalybeus* (Wagler, 1830), inasmuch as their known ranges are allopatric (whether in reality significantly dichopatric, or essentially parapatric, is unknown) and only ventral counts now appear to differ. Indeed, on the contrary, postocular counts and ventral pigmentation suggest that the populations inhabiting the environs of Jalisco may well be taxonomically distinct from either of the other two, at least at subspecific rank.

Clearly more material, particularly of *G. chalybeus* auct., is essential to clarify the taxonomy of this complex. Until that time we maintain the taxonomic status quo, because adoption of any alternative would be essentially an exchange of one uncertainty for another, with its accompanying nomenclatural vacillation and confusion.

Geophis duellmani Smith and Holland

Two adults (MZFC 5081), both DOR males, are from La Esperanza, 1700 m, 80.5 km S Tuxtepec, Oaxaca, less than a km from the type locality, 2 mi S Vista Hermosa (apx. 3 km N La Esperanza). Only four other specimens have been reported in the literature (Campbell et al., 1983), all from 2.8 to 6.6 km S Vista Hermosa, but including only one male. The present two accordingly extend the known range of certain characters of males: ventrals 126.5, 129 (from 133); subcaudals 40, 43 (from 43); dark saddles 16-18 on the two sides of one, 21-22 on the other (from 18-21 in both sexes). Other characters conform with previous descriptions. Total lengths are 214 and 230 mm, tail 42 and 47 mm respectively.

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OBSERVATIONS ON THE SENSITIVITY TO HIGH TEMPERATURES IN TWO LIZARD SPECIES (*AMEIVA UNDULATA* AND *SCELOPORUS HORRIDUS*) FROM ZACATEPEC, MORELOS, MEXICO

Julio A. Lemos-Espinal, Royce E. Ballinger and Juan M. Javelly-Gurria

Studies on lizard thermal physiology have increased since the early work of Cowles and Bogert (1944). However, there has been relatively little work on thermal characteristics of Mexican lizard species beyond an initial study by Bogert (1949) on the genus *Sceloporus*. In his classic study, Brattstrom (1965) reported the ecritic body temperatures and upper thermal limits for some Mexican lizard species. More recently Ballinger et al. (in manuscript) documented active body temperature and heat tolerance for *Xenosaurus grandis* located at Cuautlapan, Veracruz, Mexico, and Lemos-Espinal (1992) compared active body temperatures and heat tolerance of two populations of the high altitude lizard *Sceloporus grammicus* on the Iztaccihuatl Volcano, Puebla, Mexico. Here we report sensitivity to high temperatures in two lizard species (*Ameiva undulata* and *Sceloporus horridus*) from the vicinity of the city of Zacatepec, Morelos. In general, teiids are active at higher temperatures and have higher thermal sensitivities than iguanids (Brattstrom 1965). However, no studies have specifically examined sensitivity to high temperatures in these species at a single location and time, where exposure to prevailing thermal conditions that affect physiological acclimation would be the same.

Between June 15-20, 1992, twenty adult *Ameiva undulata* (average snout-vent length $109.1 \text{ mm} \pm 2.10 \text{ SE}$, and body mass $37.17 \text{ g} \pm 2.44 \text{ SE}$) and fifteen *Sceloporus horridus* (average snout-vent length $95.33 \text{ mm} \pm 1.95 \text{ SE}$, and body mass $35.53 \text{ g} \pm 1.95 \text{ SE}$) were collected at 910 m elevation in the Camp de Investigaciones Forestales y Agropecuarias de Zacatepec, Morelos (CIFAZM). Individual *Ameiva undulata* were captured by hand. They are commonly observed on the ground close to artificial water canals that surround the facilities of CIFAZM. Individual *Sceloporus horridus* are commonly observed on walls of CIFAZM and were captured by hand or noose. Average body temperatures were significantly higher in *Ameiva undulata* than in *Sceloporus horridus* (Table 1). Since all lizards we collected required considerable effort, the body temperatures we obtained reflect high metabolic activity and do not represent equilibrium ecritic body temperatures.

Lizards were placed in lab conditions at 25° C and were tested for

sensitivity to high temperatures within 12 hrs of collection. Lizards were heated continuously with a lamp (250 W) suspended 20 cm above the lizard. The lizard was tethered on a surface covered with aluminum foil to avoid substrate heating. We recorded the body temperature (cloacal temperature) with a quick reading Schultheis thermometer at four sequential behaviors (Hertz et al. 1979): (1) Experimental voluntary maximum (EVM) was the body temperature at which an individual lizard first attempted to escape the heat source (Ruibal 1961), (2) Continuous escape (CE) was an escape reaction period characterized by continuous running activity (Ballinger and Schrank 1970), (3) Panting threshold (PT) was recorded as the temperature when the lizard gaped and breathed deeply (Heatwole et al. 1973), and (4) The critical thermal maximum (CTM) was recorded as the temperature at which locomotor activity became so disorganized that the animal could not escape conditions that would promptly lead to its death as evidenced by paralysis and loss of a righting response (Pough and Gans 1982). After CTMs were noted, lizards were quickly removed from the heat source and allowed to recover. Full recovery occurred within minutes in all lizards tested.

Sensitivity to high temperatures between species was compared using analyses of variance (ANOVA). There were significant differences in the tolerance to high temperatures in all behaviors (Table 1). *Ameiva undulata* tolerated higher temperatures than *Sceloporus horridus*. These results are consistent with other studies on teiids that have reported CTMs as high as 46.2° C in *Ameiva ameiva*, 45.1° C in *Ameiva quadrilineata* (Brattstrom 1965), and 51.0° C in *Cnemidophorus sexlineatus* (Paulissen 1988). On the other hand, CTMs for *Sceloporus* lizards range from 41.17 for the high altitude lizard *Sceloporus grammicus* (Lemos-Espinal 1992) to 46.8° C in *Sceloporus occidentalis* (Brattstrom 1965).

Ecologically limiting temperatures, as represented by the CTM, are clearly lower in *Sceloporus* than *Ameiva*. Data reported here on species from the same locality and time suggest that the differences in thermal sensitivity have a genetic or phylogenetic basis since both species have access to the same environmental conditions. However, Hertz (1979) found that thermal sensitivities among *Anolis* species were predicted better by ecological distributions than phylogeny. Whether the differences we observed are a result mediated by behavioral choices of activity times and thermal preferences or by physiological differences in metabolic pathways remains to be examined.

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Table 1. Indices of heat tolerance in *Ameiva undulata* and *Sceloporus horridus* from Zacatepec, Morelos, Mexico. Mean temperatures (Celsius \pm 2 se) are given for experimental voluntary maximum (EVM), continuous escape (CE), panting threshold (PT), and critical thermal maximum (CTM).

FIELD TEMPERATURES ¹			
	Species		
	<i>A. undulata</i>	<i>S. horridus</i>	F _{1,33}
BODY	39.60 \pm 0.34	35.74 \pm 0.41	51.86***
AIR	29.68 \pm 0.61	27.86 \pm 0.85	3.17 ^{NS}
SUBSTRATE	33.81 \pm 0.82	30.07 \pm 0.95	8.83**
SENSITIVITY TO HIGH TEMPERATURES			
EVM	39.34 \pm 0.58	36.38 \pm 0.28	66.71***
CE	41.25 \pm 0.39	38.77 \pm 0.17	106.97***
PT	42.50 \pm 0.32	40.12 \pm 0.22	129.25***
CTM	45.39 \pm 0.37	43.22 \pm 0.37	64.46***

¹Temperatures represent high metabolic activity (continuous running).
 NS = Not significant; ** P < 0.01; *** P < 0.001.

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THE RANGE OF THE SO-CALLED RELICTUAL INTERGRADES BETWEEN THE LIZARDS *SCELOPORUS UNDULATUS GARMANI* AND *S. U. ERYTHROCHEILUS*

Hobart M. Smith, David Chiszar, Emmett Evanoff and Jeffry B. Mitton

The so-called intergrades occur only on slabby, moderately well indurated sandstone ledges associated with loose, highly sandy soils, exposed over at least a dozen meters of extent, where skunkbushes are abundant, in a range including no more than 5% of 25 square miles. The taxonomic status of the population remains uncertain, although it may be resolved by electrophoretic studies now in progress. Intermediacy between *S. u. garmani* and *S. u. erythrocheilus* now seems unlikely; they represent different exerges and act as different species at their latitudinal levels. More likely is intermediacy between *S. u. garmani* and *S. u. consobrinus*, both of the central exerge, and the latter (or its progenitors) having given rise to the former.

Ever since the extraordinarily stenotopic and stenochoroic (Gr. steno, restricted; choros, land, country) population of *Sceloporus undulatus* (Bosc and Daudin) was accidentally discovered in June, 1989 (Smith et al., 1991), efforts have continued to establish the range of that population. We have now bracketed its distribution, and here summarize present knowledge.

In the original report (Smith et al., 1991), the "intergrades" between *Sceloporus undulatus erythrocheilus* Maslin and *S. u. garmani* Boulenger were noted as apparently restricted to Fox Hills Sandstone exposures, shunning the extensive limestone outcrops bordering the sandstone habitat to the east and even interdigitating within some areas. That description is in error, to the extent that no limestone occurs in the area.

Two major sandstone formations are exposed in the area: the Miocene Ogallala Formation and the Cretaceous Fox Hills Sandstone. The Ogallala Formation is primarily composed of conglomerate and conglomeritic sandstones that are arkosic (derived from granite) and strongly cemented with calcite. Ogallala rocks weather into very large boulders. The Fox Hills is composed of quartzose sandstones of two basic types. One type is fine-grained, well indurated from calcite cement, and weathers into slabs. The other type is coarser grained and is indurated to varying hardnesses by iron oxide cement. Iron oxide sandstones weather either into hard blocks or loose

sand. Adjacent to these formations (Fig. 1) lie extensive Cretaceous deposits of the younger Laramie Formation, composed of coals, carbonaceous shales, mudstones, and muddy sandstones, and the older Pierre Shale, composed mostly of dark, highly organic shales.

Three factors appear to be critical in choice of habitat by lizards: 1) presence of hibernacula, as deep crevices in sandstone outcrops; 2) accessibility of a loose, sandy soil for nesting; and 3) the presence of skunkbush (*Rhus trilobata*) for cover. The lizards are most abundant on the calcite and iron-oxide cemented Fox Hills sandstones that weather into slabby, moderately well indurated ledges associated with loose, highly sandy soils. Hard, blocky, dark-colored sandstone outcrops and slabby outcrops associated with hard, compact soils are not utilized by the lizards. Absence of the lizards in Ogallala sandstone is probably due to a combination of a paucity of hibernacula (Ogallala sandstones lack suitable crevices) and their association with compact, gravelly soils resistant to nest excavation. Skunkbush abounds in most places on both the Fox Hills and Ogallala sandstones, and does not seem to be a limiting factor.

Small, isolated sandstone exposures likewise are not inhabited by *Sceloporus*. The lizards are most abundant where continuous stretches of sandstone exist, of a dozen meters or more. Even there the animals may not occur, if the area is relatively barren. The ideal condition appears to require numerous skunkbushes growing at the edges of sandstone slabs. The lizards appear to thermoregulate by alternating between the sunlight and shade that dapple the rock surface under the bushes. Certainly they wander a bit from the shelter of those bushes over rocks, but they seem not to linger long elsewhere, except for females seeking sand in which to lay their eggs. Where yuccas are the major potential sheltering plant over sandstone, the lizards do not occur.

Even where conditions appear to be most favorable, with widespread sandstone exposures and abundant skunkbush, the lizards are difficult to find. They are rarely seen unless they move, hence the most effective approach is to scan sharply the overhang area of bushes over rocks, while carefully prodding or trampling the vegetation. The lizards are thus induced to move and thereby are detected. They are very secretive, usually not exposing themselves, and in addition appear to be scarce. Three or four lizards an hour is a good rate of discovery.

The accompanying map (Fig. 1) indicates all of the localities where the "intergrades" have so far been taken. We did not find them where the circles are placed near the bottom of the map. The southernmost pair of those circles indicates a very favorable-appearing exposure of sandstone

caprock south of I 70; it is likely that the absence of these lizards is due to the nearly complete absence of skunkbush. Yuccas are present in abundance, many bordering sandstone slabs, but apparently the density of their shade and cover is unacceptable; otherwise the habitat seems suitable. The area is overgrazed, and that may account for the rarity of skunkbush.

The other pair of circles, north of I 70, represents an extensive exposure seemingly very similar to the lizardless exposures south of I 70. It, however, consists almost entirely of a thin layer of fine-grained, strongly indurated, calcareous sandstone, where crevices do exist that seemingly would suffice for overwintering. Skunkbush is also abundant. The habitat appears to be suitable for these *Sceloporus*, except for the compacted soil produced by the weathered sandstone. Whatever the reason, no *Sceloporus* are there. The small exposure on the eastern end of the ridge is strongly indurated, iron oxide-cemented sandstone, and free of crevices. Its small extent and absence of crevices make it unsuitable for these lizards.

Large, similar exposures of exceptionally hard, blackened sandstone occur farther southwest (8-16 km) near state highway 86 to Kiowa, but are devoid of *Sceloporus*. Isolated exposures of sandstone with skunkbush were examined 14 air miles west and three miles south of Deer Trail (12 mi NNW Agate), on escarpments bordering West Bijou Creek, without success. Extensive sand deposits in the same general area yielded no evidence of *Sceloporus*. The extensive exposures of Ogallala sandstone on the east escarpment of Beaver Creek are devoid of *Sceloporus*. The northern circles mark the areas of exposed, flat, fine-grained, calcareous sandstone where no *Sceloporus* were found.

It is our impression, therefore, that the "intergrades" are restricted to the general area shown in Fig. 1, where we have found them. To the north, no rock exposures exist. To the east, valleys have no rock exposures, and hills are capped with uninhabited Ogallala sandstone. To the south, no favorable habitat exists in spite of propitious topography and rock outcrops. And to the west, only weakly dissected, mostly flat farmland exists.

The "intergrade" population therefore seems to be limited to the north side of the terminus of the Palmer Divide, which separates the South Platte River drainage to the north from the Arkansas River drainage to the south. The range includes hills bordering the headwaters of Rattlesnake Creek, extending to the west slopes of Beaver Creek to the east, and the east slopes of Muddy Creek to the west.

In all, the range of the intergrade population probably does not exceed 25 square miles, and within that territory the lizards are confined to a particular type of sandstone exposure that does not comprise more than

at most 5 per cent of the total area. The number of individuals is no more, we estimate, than at most 5000. The population is in jeopardy because of its small size and limited habitat. However, its main threat seems to be overgrazing (which risk is minimized by the rough topography) and a hypothermic climatic change. With a long-term hypsithermal climatic change, its present tenuous existence might improve. Its predators (raptors, snakes, carnivores) are likely to be held at bay to some extent by human interference, which in turn is not likely to increase greatly through the foreseeable future in this rugged ranching land, totally unsuitable for farming.

The taxonomic status of the "intergrade" population remains a question. It appears superficially simply like *S. u. garmani*, from which it differs primarily in behavior and habitat, secondarily in development of ventral semeions in both sexes, and to a minor degree in femoral pore and interfemoral scale counts (Smith et al., 1991). Isozyme electrophoretic comparisons with *S. u. garmani* and *S. u. erythrocheilus*, now in progress, may provide useful information in this context. Comparative ethologies are also contemplated. Such studies should narrow the range of possibilities relative to taxonomic status of the "intergrades." At present those possibilities are: (1) as previously hypothesized, relictual intergrades between *S. u. garmani* and *S. u. erythrocheilus*; (2) a peripheral variant of *S. u. garmani* with no relation to *S. u. erythrocheilus*; and (3) relictual intermediates, taxonomically distinct or not, between *S. u. garmani* and *S. u. consobrinus* Baird and Girard, from which the former was presumably derived, representing an intermediate stage in reduction of its semeions (well developed in the latter taxon).

Similarity of the "intergrades" to *S. u. erythrocheilus* lies primarily in the hypertrophied semeions, as compared with *S. u. garmani*, in which they are poorly developed, and these were the two taxa in which relationships were first sought, since they are the ones adjacent to the "intergrade's" range. However, accentuated semeions are characteristic of members of the *S. undulatus* group as a whole; in *S. u. garmani* they are greatly reduced. Hence the "intergrades" might well be interpreted as simply an isolated remnant of an ancestral population, with modest semeions, that elsewhere continued the reductional trend in semeion development, becoming the current *S. u. garmani*.

Considerations of the proper nomenclature for the "intergrades" should also take into account the deeply ingrained behavioral differences between the three subspecies groups (exerges) of *S. undulatus*. The eastern exerge (*S. u. hyacinthinus* [Green], *S. u. undulatus*) is scansorial (climbing) in habits, mostly on trees; the western exerge (*S. u. elongatus* Stejneger,

S. u. erythrocheilus, *S. u. tristichus* Cope) is also scansorial, on both trees and rocks, but mostly the latter; and the central exerge (*S. u. consobrinus*, *S. u. cowlesi* Lowe and Norris, *S. u. garmani*, *S. u. tedbrowni* Smith et al.) is terrestrial. In this context, the "intergrades" are terrestrial, not scansorial, in spite of being partial to a rocky habitat. For them, rocks are a part of a terrestrial habitat, to which they are mostly confined; their behavior is definitely not scansorial. In that context, they are clearly a member of the central exerge, and therefore it now seems very unlikely that they represent intermediates between that exerge and the western one, because at the latitudes where *S. u. garmani* (central exerge) and *S. u. erythrocheilus* (western exerge) occur, they act as different species, maintaining their extensive differences in ranges coming within at least very few kilometers of each other. They are not yet known to be sympatric, but they probably are. Blending of the two exerges occurs farther south, between *S. u. consobrinus* (central exerge) and *S. u. tristichus* (western exerge).

Nevertheless, the Great Plains, where the "intergrades" now occur, were forested or wooded during the late Wisconsin glacial epoch (Axelrod, 1985), providing a habitat where some member (presumably *S. u. erythrocheilus* or its forerunner) of the western exerge may have occurred. As the forest subsequently receded to the east and west, while the Great Plains expanded between, ample opportunity may have existed for reproductive contacts to have occurred between the evolving scansorial and terrestrial exerges, even though at present there is none at least between *S. u. garmani* and *S. u. hyacinthinus* on the east, the former and *S. u. erythrocheilus* on the west.

Thus none of the three possibilities, relative to the ancestry and current taxonomic status of the so-called "intergrades", can be conclusively accepted over the others on the basis of present knowledge. Electrophoretic studies in progress may well restrict the possibilities.

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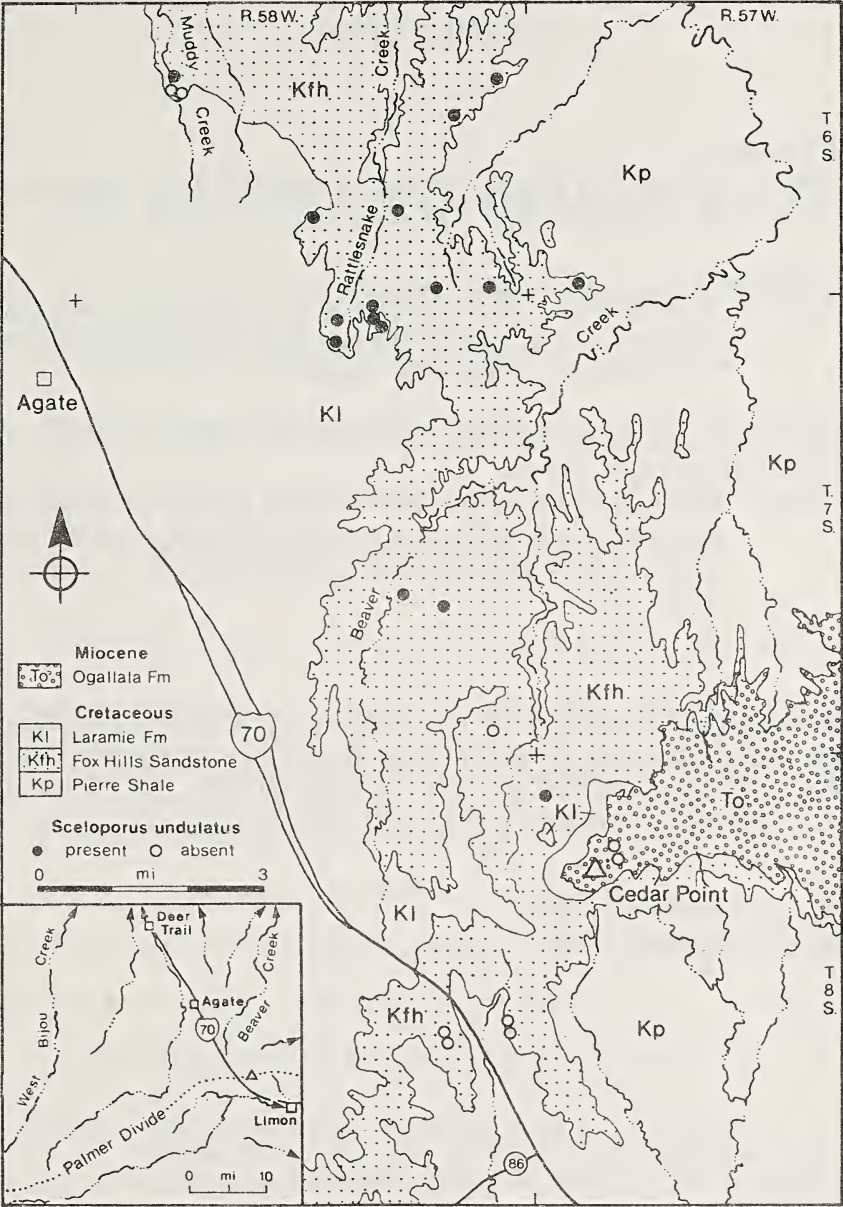


Fig. 1. Distribution of the isolated population of *Sceloporus undulatus* near Agate, Elbert Co., Colorado. Map traced from the Bureau of Land Management's 1985 Limon and Last Chance 1:100,000 scale metric topographic maps. Geology after Sharps (1980). Solid dots indicate sites where samples were found, hollow dots sites where habitats might be suitable but where no lizards were found.

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TROPICAL DIVERSITY

OTS 93-10

*An Intensive Field-Oriented Introduction to Tropical Diversity in Rainforest,
Seasonally Dry Forest and Cloud Forest Ecosystems*

August 2 - 26, 1993

COSTA RICA

Objectives: To study the diversity of plants, animals and biotic interactions found in three types of tropical forests: rainforest, seasonally dry forest and cloud forest. Participants will learn about these tropical environments and their conservation via orientation walks, faculty-led field research projects, discussions and lectures.

Tropical Diversity will be conducted in Costa Rica at the OTS operated field stations in lowland rainforest (La Selva) and seasonally dry forest (Palo Verde), and at a mid-elevation site, Volcán Cacao, in Guanacaste National Park. After one day of orientation and introductory lectures in San José, the class will operate entirely in the field, spending one week at each of these sites. The schedule at each site will include: a detailed introduction on the day of arrival, orientation walks, three days of field problems, two days of writing and self-orientation, and lectures/discussions in the evenings. Participants will present oral reports on field projects, write reports, and edit each other's reports. Grades will be based on participation in course activities and the quality of oral and written reports.

Coordinators: Dr. Maureen Donnelly, University of Miami

Ms. Monica Marquez, University of Florida and OTS

Enrollment: Limited to 22. Applicants are selected on the basis of background and goals related to the objectives of the course. Priority is given to superior applicants who are enrolled in, or accepted for, graduate programs at OTS member institutions. Some slots (about 25% in recent years) may be available for students from institutions that are not members of OTS, as well as for recent Ph.D.s who seek professional training in the tropics.

Application Deadline:

April 15, 1993

Announcement of Selections:

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NOTES

Tropical Diversity, OTS 93-10
Application Information

Costs: (1) Application fee:	\$10
(2) Course fee:	\$1,550 OTS members' students* \$2,600 Non-OTS member students
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- (1) A processing fee of \$10 must accompany the completed application.
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- (3) Personal expenses such as laundry, mail, entertainment, visas, insurance, medical expenses, gifts, etc. are not covered. Also, students planning additional time in Costa Rica before or after the course should allow \$30 per day extra.
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Prerequisites: A minimum of four graduate courses in biology, or approval of the course coordinator.

Credit: Three (3) semester hours: transcript issued by Universidad de Costa Rica.

Consultation: Perspective applicants from member institutions must consult with one of the two representatives to the OTS Board of Directors at their institution. Advice and endorsement by the local representative are a necessary part of the evaluation process.

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NOTES

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WORLD CONGRESS OF HERPETOLOGY

Call for nominations for membership of the Executive and International Herpetological Committee.

During the Second World Congress of Herpetology, to be held in Adelaide, Australia between December 29, 1993 and January 6, 1994, half of the members of the Executive Committee and half of the members of the International Herpetological Committee will retire. Membership to both these committees is open to all herpetologists and should be as representative as possible of herpetological subdisciplines and the geographic distribution of herpetologists. Retiring members are eligible for re-election.

Nominations to fill the vacancies can be taken now till August 29, 1993.

Nominations must be seconded either by any two members of either the Executive or International Herpetological Committees, or, in the case of the International Herpetological Committee, by the governing body of an Affiliated Organisation.

Where the number of nominations exceeds the number of vacancies then the election will be by open ballot (during the business meeting) of a format to be determined by the Executive Committee.

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SATURDAY, APRIL 17TH, 1993

The All Florida Herpetology Conference is cosponsored by the Florida Museum of Natural History and the Gainesville Herpetological Society. The conference will be held on the campus of the University of Florida at Reitz Union Auditorium. We prefer you preregister using the form below, but late registrations will be accepted starting at 8 a.m. the day of the conference, at a higher cost to you. Talks start at 9 a.m.

Speakers will be: Mary Allen, National Zoological Park, Washington, D.C.; William S. Brown, Department of Biology, Skidmore College, Saratoga Springs, New York; Edward Maruska, Director, Zoological Society of Cincinnati, Cincinnati, Ohio; Roy W. McDiarmid, United States Fish and Wildlife Service, National Museum of Natural History, Washington, D.C.; Joan E. Diemer, Kevin M. Enge, and Paul E. Moler, Florida Game and Fresh Water Fish Commission and Walter W. Timmerman, Florida Department of Natural Resources, James B. Murphy, Curator, Department of Herpetology, Dallas Zoo, Dallas, Texas; Henry R. Mushinsky, Department of Biology, University of South Florida; John Thorbjarnarson, Wildlife Conservation International, Bronx, New York; and Trooper Walsh, National Zoological Park, Washington, D.C.

Other events include a panel discussion on the conservation of the Eastern Diamondback rattlesnake; a parasite detection workshop presented by Richard Funk, DVM, Brandon, Florida; a workshop for young herpetologists, presented by Patricia Ashton, Morningside Nature Center, City of Gainesville; exhibition and sale of herpetological books, art, etc.; and an evening barbeque and auction at the Florida Museum of Natural History.

DIRECTIONS: From the intersection of State Road 26 (University Avenue) and U.S. 441 (S.W. 13th Street), drive south on U.S. 441 until you reach Museum Road (S.W. 8th Avenue). Turn west (right) on to campus and proceed less than one-half mile, until you reach Reitz Union. Watch for A.F.H.C. signs.

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NOTES

Society for the Study of Amphibians and Reptiles

Herpetological Circular No. 22
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William S. Brown

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This SSAR publication partially financed and co-sponsored by

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Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are \$2.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at \$.25/page.

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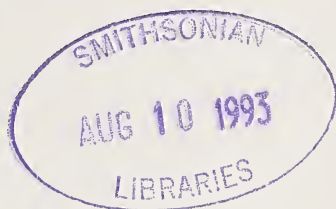
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30 JUNE 1993

VOLUME 20 NUMBER 2

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Volume 29 Number 2

June 1993

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The Maryland Herpetological Society
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BULLETIN OF THE

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Volume 29 Number 2

June 1993

The Maryland Herpetological Society
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Membership Rates

Membership in the Maryland Herpetological Society is \$16.00 per year. Foreign \$20.00/year. Make all checks payable to the Natural History Society of Maryland, Inc.

Meetings

The third Wednesday of each month, 8:15 p.m. at the Natural History Society of Maryland (except May—August, third Saturday of each month, 8:00 a.m.). The Department of Herpetology meets informally on all other Wednesday evenings at the NHSM at 8:00 p.m.

SLEEP-LIKE BEHAVIOR IN YOUNG, CAPTIVE RED-EARED SLIDERS (*TRACHEMYS SCRIPTA ELEGANS*)

Floyd E. Hayes

Sleep-like behavior was studied in young, captive red-eared sliders (*Trachemys scripta elegans*), and compared with an earlier field study on Galápagos tortoises (*Geochelone elephantopus vandenburghi*). The turtles were nearly always "awake" during the day and "asleep" during the night; when "asleep" they were usually completely submerged. When basking on land during the day, *T. scripta* usually remained vigilant whereas *G. elephantopus* usually exhibited sleep-like behavior; differences in the antipredator strategies of these species may explain the differences in vigilance during basking. Both species usually basked with the head and limbs extended, and slept at night with head and limbs retracted; these postures presumably serve a common thermoregulatory function.

The electrophysiological presence of sleep has been documented in a variety of turtle species (e.g., Herman et al., 1964; Vasilescu, 1970; Karmanova and Churnosov, 1972; Flanigan, 1974; Flanigan et al., 1974; Ayala-Guerrero, 1987, 1988). But because most previous studies of chelonian sleep focused on the electroencephalographic correlates of specific sleep states, much remains to be learned about the ecological significance of behavioral sleep in chelonians. Hayes et al. (1992) briefly studied sleep behavior in wild Galápagos tortoises (*Geochelone elephantopus vandenburghi*), and found that the tortoises generally slept at midday (apparently while basking) with the head and limbs extended, and slept at night with the head and limbs withdrawn. However, in the absence of electroencephalographic data, they preferred using the term "sleep-like" behavior.

As with most species of turtles, previous reports of sleep-like behavior in the slider turtle (*Trachemys scripta*) are anecdotal. Moll and Legler (1971) reported that sliders in Panama were inactive at night, and slept at the edges of vegetational mats with the head and dorsal half of the carapace out of the water. Gibbons et al. (1990) noted that sliders seen at night in Georgia were normally underwater on the surface of the mud or buried beneath the substrate. Granda and Maxwell (1978) reported that captive sliders slept on the bottom of the tank, and about once an hour they opened their eyes, raised their heads to the surface, breathed, and then submerged again. Here I report observations on the sleep-like behavior of

young, captive red-eared sliders (*T. s. elegans*), and compare the behavior of *T. scripta* with that of *G. elephantopus*.

Methods

In March and April 1986, five young *T. s. elegans* (33-36 mm straight carapace length) obtained from a dealer were maintained indoors in a 38-liter aquarium during a 12:12 light:dark photoregime, with the onset of light at 0700. The aquarium contained a rock providing terrestrial habitat for approximately 25% of the surface area; water 7-8 cm deep covered the remaining surface area. Water temperatures ranged from 18.3°C at night to 23.3°C during the day, and air temperatures ranged from 19.4-25.0°C. The turtles were fed freeze-dried *Tubifex* sp. nearly every morning. Three turtles fed regularly, and appeared to be in excellent health; the other two refused to feed and eventually died.

Observations of sleep-like behavior were made randomly. In the absence of electroencephalographic data, I considered the turtles to be "asleep" when immobile with the eyes closed for 30+ sec, and "awake" when the eyes were open (cf. Flanigan, 1974; Flanigan et al., 1974; Hayes et al., 1992). During each observation I recorded for each individual turtle the substrate occupied (land or water), whether or not the head and/or tail were extended, the number of legs extended (1-4), the vertical angle of the longitudinal body axis (< or > 45°), and the sleep state ("asleep" or "awake") of the turtles. Observations were made during both light phases (light and dark); during the dark phase, observations were facilitated with the use of a red light. A total of 207 observations, 69 for each turtle, were made for each healthy turtle; data on the unhealthy turtles, which were virtually always "asleep," were rejected. A minimum of 60 min elapsed between successive observations, and no more than two observations were taken within a 6 hr period; independence between observations was assumed.

To determine if the three individual turtles differed in their behavior, I computed a series of three-way likelihood ratio chi-square tests by using log-linear models (X^2_L statistic; Everitt, 1977). Each test examined the relationships between the individual turtles, their sleep state, and one of the other variables associated with sleep-like behavior (light phase, substrate choice, head extension, legs extended, tail extension, and body angle). The significance of the first-order interaction term (calculated as the difference in df and X^2_L between the main effects model and the independent addition of the first-order interaction term; see Everitt, 1977) indicated whether there was individual variation in behavior. When there was no significant individual variation in behavior, I assumed independence and combined data for all individuals. I then examined the relationships between variables using

conventional two-sample chi-square tests (X^2 statistic; Siegel 1956). All statistical tests were computed with Statistix software (Heisey and Nimis, 1985); all probabilities are two-tailed, with $\alpha = 0.05$.

Results

The significance of the first-order interaction terms between individual turtles and the variables associated with sleep-like behavior indicate that there was little individual variation; only with respect to tail extension did the turtles differ significantly in their behavior (Table 1). The consistent behavior of the turtles is illustrated by the observation that during the dark phase all three turtles were "asleep" 88.5% of the time ($N=26$ observations), while during the light phase all three turtles were "awake" 88.4% of the time ($N=43$).

When the data for the three turtles were combined, they were "awake" 94.5% of the time during the light phase ($N=129$ observations), but only 5.1% of the time during the dark phase ($N=78$; $X^2=159.54$, $df=1$, $P<0.001$; see Table 2). During the light phase, the turtles were usually in the water (79.1% of the time, $N=129$); when in the water they were seldom "asleep" (4.9% of the time, $N=102$; see Table 2). When on land, the turtles were usually basking while remaining vigilant (i.e., alert with the eyes open), and were "asleep" only 7.4% of the time ($N=27$; Table 2). During the dark phase, the turtles were almost always in the water (96.2% of the time, $N=78$); when in the water they were almost always "asleep" (94.7% of the time, $N=75$; Table 2). During the dark phase, the turtles were nearly always "asleep" in the water (95.9% of the time, $N=74$), but were occasionally "asleep" on land (Table 2).

When "asleep," the head, legs and tail of the sliders were retracted more often than not, but the expression of these postures was highly variable (Table 3). The turtles often "slept" pressed up against the sides of the rock in a relatively vertical position, but also "slept" on the floor of the aquarium in a relatively horizontal position (with roughly equal frequency; Table 3). When "asleep" in water, the turtles always remained completely submerged, but when in the vertical position, the head was frequently close to the surface. The turtles assumed a more vertical position more frequently when "asleep" than when "awake" (Table 3).

Discussion

When considering the relative homogeneity of an aquarium environment and the small number of turtles in this study, it is not surprising that the individual turtles exhibited few differences in sleep-like

behavior. In a natural environment, greater individual variation in sleep-like behavior may be expected since microhabitat characteristics vary greatly. Aquatic turtles are adapted to aquatic environments and are capable of remaining submerged for long periods of time. Hence it is not too surprising that the turtles in this study preferred to sleep while submerged.

The vigilant behavior exhibited by young *P. scripta* while basking contrasts with that of *G. elephantopus*, which usually rests in sleep-like repose when basking (Hayes et al., 1992). These differences may be due to differences in their antipredator strategies. When approached by a potential predator, *G. elephantopus* and other terrestrial tortoises generally withdraw their limbs and remain stationary, relying primarily upon their domed carapaces with small external openings for defense (Hayes et al., 1988; Hayes, 1989). While basking, *P. scripta* and other aquatic turtles usually flee into the water and hide when approached by a potential predator (e.g., Moll and Legler, 1971; Hayes, 1989). Because *P. pseudemys* flees into another medium when threatened by predation, remaining awake and alert while basking would seemingly be more advantageous than it would for *G. elephantopus*. However, *G. elephantopus* has few, if any, natural predators (Hayes et al., 1988). Adult *P. scripta* tend to flee more quickly than immatures, possibly because immatures rely more upon cryptic coloration and concealment to avoid predators (Moll and Legler, 1971).

Both *P. scripta* and *G. elephantopus* usually basked with the head and limbs extended, and slept at night with the head and limbs retracted. Similar postures have been recorded in other species of terrestrial tortoises, and are usually associated with thermoregulatory behavior (e.g., Voigt, 1975; Douglas and Layne, 1978). Heat may be absorbed by aquatic turtles during periods of basking by extending the limbs and head, and may be conserved at night by decreasing the surface to volume ratio when the head and limbs are withdrawn, thus reducing heat loss by conduction and convection. These postural adjustments, apparently exhibited by both aquatic and terrestrial turtles, thus appear to have a common thermoregulatory function. However, much more research is needed to better understand the ecological ramifications of behavioral sleep in turtles.

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Table 1. Results of first-order interactions (from three-way log-linear analyses; see text) to determine whether variables associated with sleep-like behavior in *Pseudemys scripta elegans* differed between the individual turtles.

Variables	χ^2_L	df	P
Individuals X Light Phase	0.00	2	1.00
Individuals X Sleep State	0.12	2	0.94
Individuals X Substrate Choice	3.83	2	0.15
Individuals X Head Extension	3.02	2	0.22
Individuals X Legs Extended	14.02	8	0.08
Individuals X Tail Extension	8.24	2	0.02
Individuals X Body Angle	1.82	2	0.40

Table 2. Conditional cell totals for the sleep state and substrate choice of *Pseudemys scripta* during different light phases. The data for all turtles are combined.

Sleep State	<u>Light Phase</u>		<u>Dark Phase</u>	
	Land	Water	Land	Water
"Awake"	25	97	0	4
"Asleep"	2	5	3	71

Table 3. Conditional cell totals for postural variables associated with sleep-like behavior in *Pseudemys scripta*, independent of light phase and substrate choice. The data for all turtles are combined for each postural variable except tail extension (see text).

Variable	"Awake"	"Asleep"	χ^2	df	P
Head					
Extended	116	31	66.7	1	<0.001
Retracted	10	50			
Legs Extended					
Zero	5	31	83.96	4	<0.001
One	9	13			
Two	6	18			
Three	7	5			
Four	99	14			
Tail of Turtle 1					
Extended	40	20	43.76	1	0.03
Retracted	2	7			
Tail of Turtle 2					
Extended	38	11	14.54	1	<0.001
Retracted	5	15			
Tail of Turtle 3					
Extended	37	10	20.34	1	<0.001
Retracted	4	18			
Body Angle					
<45°	100	38	21.93	1	<0.001
>45°	26	43			

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FIRST RECORD OF *AMPHISBAENA DUBIA* MULLER (REPTILIA: AMPHISBAENIA) IN ARGENTINA

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One specimen of *Amphisbaena dubia* Muller was found at El Bagual Ecological Reserve, Northeastern Argentina, within a termite mound in a *Paspalum* grassland. This is the first record of the species in Argentina, previously only known from Brazil. Our locality is more than 900 km west of the Brazilian state of Santa Catarina, the southernmost limit for *A. dubia*. Both localities are at the same latitude (26°S). The specimen is clearly assignable to *A. dubia* and is unlike any of the nine species of *Amphisbaena* previously reported for Argentina.

Se encontró un ejemplar de *Amphisbaena dubia* Muller en la Reserva Ecológica El Bagual, noreste de Argentina, dentro de un termitero ubicado en un pastizal de *Paspalum*. Este es el primer registro de la especie en Argentina, previamente conocida para Santa Catarina (Brasil), con su límite sur de distribución a más de 900 km de El Bagual. Ambas localidades se encuentran aproximadamente a la misma latitud (26°S). El espécimen fue fácilmente assignable a nivel específico y difiere de las nueve especies de *Amphisbaena* previamente citadas para Argentina.

Introduction

One of our goals is an evaluation of the herpetofauna associated with terrestrial termite mounds within El Bagual Ecological Reserve (26° 10' 58" S, 58° 56'39" W). On 15 September 1991 an amphisbaenid was found while opening one of several termite mounds on the reserve. Attempts to determine the specimen's identity made us conclude that it did not belong to any of the known species of Argentine amphisbaenids. The specimen was sent abroad for identification and all conclusions indicated that it was *Amphisbaena dubia* Muller.

The genus *Amphisbaena* in South America has received little attention beyond Gan's works of the 1960 and 1970's. Particularly, *A. dubia* was described in 1924 by Muller from Piracicaba, Sao Paulo, Brazil, along with several new herpetozoa (Vanzolini 1978: 49). In 1964 Gans redescribed the species and added many new records that extended its range from the Brazilian state of Sao Paulo to the southern states of Paraná and Santa

Catarina. The southernmost locality given by Gans (1964) was Tres Barras, Santa Catarina. The latter locality is approximately at the same latitude as El Bagual (26°S), but El Bagual is 900 km west of Tres Barras. Following Gans (1964), nothing else has been reported for this species.

For Argentina, approximately nine *Amphisbaena* species have been cited (Peters and Orejas-Miranda, 1986). *Amphisbaena darwini*, *A. camura*, *A. fuliginosa*, *A. mertenii*, *A. plumea*, and *A. prunicolor* are characterized by a caudal autotomy, while our specimen does not have it. *Amphisbaena steindachneri* is characterized by more than 238 body annuli while our specimen has 231, and finally *A. alba* and *A. agustifrons*, apart from being large and thick amphisbaenids, have more than 42 segments per midbody annulus, while our specimen has 35.

Description

El Bagual collection number RED-AD-001, female, total length 19.5 cm, snout-vent length 18.0 cm, body mass 2.0 g; collected by C. Mercolli & A. A. Yanosky, 15 September 1991. A medium sized amphisbaenid without fusions of head shields; two pairs of large parietals, right parietal divided with anterior larger, left parietal undivided; two rows of postgenials, first pair normal with no segment extending forward to contact the postmental; no postmalars; blunt tipped tail without autotomy constriction; no precloacal pores because of sex, but scale indentations suggest two pores per side; body annuli 215, from angulus oris to precloacals; 10 caudal annuli; color of preserved specimen light brown and pinky.

The specimen is assigned to *Amphisbaena dubia* Muller because: 1.- it has no major fusions of head shields, e.g. prefrontals, frontals, and supralabials in pairs; 2.- it is a medium sized specimen, usually with less than 35 (29-42) segments per midbody annulus; 3.- fewer than 232 body annuli; 4.- the tail is cylindrical without basal constriction; 5.- more than 185 body annuli; and 6.- tail tip is rounded, without a marked vertical keel (Gans, 1964; Peters and Orejas-Miranda, 1986).

Our specimen differs from the redescription given by Gans (1964), by having 19 caudal annuli instead of 17; no circular spot could be found in the center of each segment and the intercalated dorsal half-annulus was found in the four precloacal annuli instead of 10; many segments at midbody appear to be lightly divided and counts ranged from 32 to 35 segments with a mode of 35. There are three supralabials and two and one half infralabials. The second supralabial is the largest, with the first supralabial next in size.

Coloration

The specimen was slight violet and rosy when alive. Preserved, dorsal segments bear a light brown appearance. Each segment has a stronger brown coloration in the anterior part, and pigments disseminate at the end of each segment. All segments appear to be bordered by a creamish coloration which allows easy segment delineation. Head and segments of the first third of the body length appear more pigmented. Ventrally, segments bear pigmentation only on the anterior part, the remainder cream colored. The cream color extends the width of the belly over most of the ventrals, but is occasionally interrupted. Throat and chin cream colored.

Habitat

Gans (1964) did not present data on the habitat of this species. Our specimen was found in *Paspalum* grassland containing a scattering of palm trees (*Copernicia alba*), and within a termite mound that contained the ant genus *Camponotus*. The amphisbaenid appeared to be in a dormant state 30 cm deep in dissociated soils, not in the very abundant termite galleries. *Amphisbaena darwini* was found associated with vegetal residum in *Acromyrmex* ant mounds by Gallardo (1977). The grassland where our specimen was found is affected annually by two natural pulses, floods in summer-autumn, and fires in winter-spring, but termite mounds remain little altered after both occurrences.

Distribution

According to localities given by Gans (1964) *Amphisbaena dubia* appeared restricted to the Paranense Biogeographical Province of Cabrera and Willink (1973). This province occupies southeastern Brazil, Misiones in Argentina, and eastern Paraguay; an area supporting 1500-2000 mm of rainfall, with a marked dry season during winter and the terrain characterized by rolling hills. The species distribution now includes the humid chaco of northeastern Argentina with similar characteristics (1200-1800 mm rainfall, marked dry season in winter-spring), except the terrain is relatively flat. The species has not been found between 52-56°W longitude, but future surveys should confirm its presence there.

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A NEW SPECIES OF KNOBSCALE LIZARD (REPTILIA: XENOSAURIDAE) FROM MEXICO

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The three species of *Xenosaurus* (*X. grandis*, *X. newmanorum*, *X. platyceps*) currently recognized (King and Thompson, 1968) occur in the tropical, mesic foothill regions on Atlantic slopes of Mexico and Guatemala, and on Pacific slopes in Oaxaca, Mexico. The discovery of another population on the Mexican plateau at as great an altitude as 2361 m (8400 ft), in a semiarid habitat, is of great interest. The first specimen collected of that population was a juvenile (now KU 140046) taken 8 May 1967, by Randy McCranie near Chapulco, southeastern Puebla. A subadult (now UF 41956) was later (21 Oct. 1970) taken by Fred G. Thompson 7.5 km (4.7) E Chapulco. Stimulated by the realization that the latter specimen belonged to no known species of the genus, JBI and companions secured a series of 10 (UF 51438-47) on 3 May 1981, about 8 km (4.7 mi) E Chapulco, at an altitude of about 2134 m (7000 ft), under flat rocks lying on other flat rocks on southeast-facing slopes (Fig. 1). The latter locality is off of Hy 150, 2.4 km (1.5 mi) southwest of the Veracruz/Puebla state line, where the species was at that time relatively abundant.

Subsequent study has corroborated the initial surmise that the population represented by the cited specimens is indeed different from any recognized at present and as reviewed by King and Thompson (1968). Comparisons of that population (herein referred to informally as the Chapulco population) with others has required use of characters not compared by King and Thompson (1968).

Materials and Methods

Comparisons of the 12 Chapulco specimens were made with 54 specimens of other taxa, listed in the Appendix, representing all three known species of the genus, and three (*X. g. agrenon*, *X. g. grandis*, *X. g. rackhami*) of the five subspecies of *X. grandis*. No examples of *X. g. sanmartinensis* and *X. g. arboreus* have been examined. All material of the genus in the Florida Museum of Natural History (UF) and the University of Colorado Museum (UCM), and all in the University of Kansas Museum of Natural History (KU) except for nine *X. g. grandis* duplicates from Cuautlapan, Veracruz, and five *X. newmanorum* from Xilitla, San Luis Potosí, has been studied.

Characters we have found useful in differentiating the Chapulco population from others are as follows.

1. *Nape mark.* The most distinctive feature of the Chapulco population is the strictly transverse direction and midnape restriction of the nuchal band (Fig. 2). In all other populations of the genus, the nuchal band is V-shaped (e.g., Fig. 3, of *X. newmanorum*) and extends posteriorly at least to the level of the foreleg insertions, and in some to the level of the axilla. It is often (regularly in *X. platyceps*) more distinct than any of the four following dark crossbands on body, especially in mature individuals. Only in rare, totally unicolor individuals (e.g., *X. g. grandis*, KU 52488) is the neck band not as described.

The nuchal collar of the Chapulco species is wholly or partly interrupted by a whitish vertebral streak, but a similar light interruption occurs in all other taxa, although weakly in most *X. g. grandis*. The nuchal band is solid black (except for the vertebral interruption) only in juveniles of all taxa and most adult *X. g. grandis*. Otherwise, the band tends toward fragmentation, less pronounced on its borders, with maturation, much as is the case for the bands on the trunk, although usually less pronounced.

2. *Ground color of dorsum.* The second most distinctive feature of the Chapulco species is the whitish dorsal ground color on body and tail. All other populations of the genus have the entire dorsum pigmented; in them a narrow tan interval separates the five broad dark bands and that ground color extends elsewhere to the head, onto the tail between its dark rings, and to the lateral fold. Only the tips of the tubercles in the light areas of the Chapulco population are clearly pigmented (Figs. 2, 4).

3. *Dark spots on venter.* None whatever occur in the Chapulco species; the whitish ventral coloration extends dorsad past the lateral fold, whereas in all other taxa the darker dorsal ground color extends ventrad past the lateral fold onto the sides of the abdomen even in those (*X. newmanorum*, *X. platyceps*) in which the venter itself is immaculate. All specimens examined of *X. grandis* have a spotted venter, at least on its sides (even in the dorsally unicolor example), although King and Thompson (1968) indicate that some *X. g. agrenon* do not have ventral dark spots. Those exceptions may represent other taxa or have the pattern obscured by premoulting changes of the epidermis.

4. *Postparietal dark spots.* In the Chapulco population, a pair of distinct, squarish dark spots is regularly present bracketing a vertebral light streak just behind the head (Fig. 2). In some specimens these spots extend forward onto the rear parietal region. In no named population of the genus do such spots occur.

5. *Postrostral*. The Chapulco population is unique in having a peculiarly bulbous, relatively large postrostral that is wider than long (1.3 to 2 times as wide as long; Fig. 4). In other populations it is usually smaller, less bulbous, and longer than wide; in some individuals it is not even recognizable. In no specimen we have examined, except in the Chapulco population, is it both large and wider than long. In one population (as yet unnamed, here termed the Yautepec population), it is usually split longitudinally.

6. *Rostral*. In all specimens of the genus the rostral and supralabial region are peculiarly protuberant, especially as seen in dorsal view. The rostral is accordingly flat-topped, except in *X. platyceps*, which has a median posterior process of the rostral that is unique to and regularly present in specimens we have examined of that species.

7. *Zygomatic-postocular ridges*. The canthus temporalis varies considerably in the genus, its prominence largely dependent upon the degree to which the temporal tubercles are separated from each other by granular scales. Where there are no or few granules, and the tubercles are in contact with each other, the canthus temporalis is not clearly evident. A longitudinal row of scales is always present on the canthus, however, and curves anteroventrally posterior to the orbit, joining the postocular ridge (on the posterior border of the orbit) below the orbit. In the Chapulco species, the two ridges are tightly in contact throughout most or all of their parallel lengths (Fig. 4), whereas in *X. g. grandis*, *X. g. agrenon*, *X. newmanorum* and *X. platyceps* they are well separated throughout their parallel lengths by 1-2 rows of flat scales, except where they meet below the orbit. *X. g. rackhami* and the Yautepec populations are like the Chapulco species in this character.

8. *Ventral scale rows*. We have found no interpopulational differences in number of transverse rows on the belly (counted posteriorly from midventer at axillary level to the preanal group of scales) or in the preanal region, or in a combination of these counts. However, the maximum transverse count is 25-29 in the Chapulco population, whereas in all other populations the variation is 18-24 (except for the unnamed Yautepec population, with 23-27).

9. *Lamellae on fourth toe*. The Chapulco population has 19-23 lamellae under the 4th toe, whereas *X. g. grandis*, *X. g. rackhami*, *X. newmanorum* and *X. platyceps* have 25-33. Only *X. g. agrenon*, with 21-29 lamellae, and the Yautepec population, with 19-24, are not separable from the Chapulco species by this criterion.

10. *Size and proximity of tubercles*. Although not stressed by King and Thompson (1968), presumably because of subjectivity of evaluation,

tubercle size and association are clearly of considerable taxonomic significance because of their marked interpopulational variation. *X. platyceps* (Fig. 5) has the most prominent tubercles, densely crowded over most of the dorsal surfaces of the body and limbs, as well as in the temporal region, except for the middorsal trunk region; the paravertebral tubercles are smaller than the lateral ones and do not form a paired row as in most other populations, in which the lateral tubercles on the trunk are smaller than or barely equal in size to the paravertebral tubercles. The distance between the lateral tubercles is to a considerable degree population-constant and interpopulation variable. For example, they are separated from each other by less than their own diameter in *X. platyceps*, by 1-1.75 times their diameter in the Chapulco species, and by 2-4 times in *X. g. grandis*. The distance between the flattened, relatively large tubercles in the paravertebral rows, where they exist, is of importance. Similarly, the tubercles on the dorsal surfaces of the thigh and brachium are in contact or separated by various numbers of rows of granules in different taxa. Also, the rear and posterodorsal temporal tubercles vary intertaxonomically in degree of separation from each other by granules.

11. *Tail/s-v proportion.* All populations of *Xenosaurus* have a tail/s-v proportion varying a little above or below equality, except for the very short-tailed Yautepec population, and the very long-tailed population near Vista Hermosa, Oaxaca.

12. *Supraorbital semicircles.* In all populations of the genus the supraorbital semicircles are separated, except for infrequent narrow contact of one or two scales, with the exception of *X. newmanorum*, in which they are regularly (fide King and Thompson, 1968, and in the one specimen we have seen) in contact.

13. *Supraoculo-orbitals.* Between the supraorbital semicircles and the *enlarged* supraoculars lie one or two rows, depending on taxon, of moderately large "supraoculo-orbitals," and also in some taxa a row of very tiny scales is present in addition to or in lieu of the moderate sized scales. The Chapulco series has but one row of moderate sized supraoculo-orbitals.

14. *Labiomentals.* In the Chapulco species, the labiamental series of scales always extends forward to the first chinshield and infralabial. In other taxa the series often ends at the 2nd or even the 3rd chinshield.

15. *Sexual dimorphism.* Females attain a somewhat greater size (expressed in s-v length) than males, apparently in all taxa of the genus. We have, however, found no clear-cut external difference between the two sexes. The base of the tail is somewhat wider in most preserved males, but not always; perhaps in life that difference is a more reliable indicator. Both sexes

have a peculiar, more or less rectangular postanal "platform" (Fig. 6) covering about six to eight scale rows; the round, posterolateral corners of that platform have their scales distinctly enlarged, so that those corners protrude from the surface of the tail. No differences in the extent of development of that platform or its protuberant rear corners are apparent in comparison of males and females. The one difference that appears to be constant is that the small scales toward the middle of the most posterior row of the platform are distinctly wider than long in males, and squarish in females. This difference is perhaps correlated with an otherwise rather imperceptibly wider base of the tail in males than in females, assuming that the number of scales does not differ. The difference in scale shape, even though probably requiring at least a hand lens to detect, may be useful to captive breeders. However, the observed difference is limited to the *X. grandis* species group, including all members of the genus except *X. newmanorum* and *X. platyceps*. The pertinent scales are squarish in both sexes of those two species.

It should be noted also that injected specimens (rather than ones slit for preservation), of both sexes of all members of the genus (although to a greater extent in females), almost always have the cloaca partially everted, obscuring the postanal platform. Presumably this propensity is correlated with parturition of large neonates.

Description

In view of the numerous peculiarities of the Chapulco population, as previously detailed, it is regarded as a previously unrecognized species that we here name

Xenosaurus rectocollaris sp. nov.

Holotype. UF 51438, adult male, 2.5 km (1.5 mi.) SW Veracruz/Puebla state line, Hy 150 (8 km (4.9 mi) E Chapulco), Puebla, Mexico, about 2134 m (7000 ft), 3 May 1981, John B. Iverson et al. *Paratypes*. Eleven, including UF 51439-47, topotypes, same collectors and date; UF 41956, 7.5 km (4.7 mi) E Chapulco, Puebla, Fred G. Thompson, 21 Oct. 1970; and KU 140046, nr Chapulco, Puebla, Randy McCranie, 8 May 1967.

Diagnosis - Definition. A member of the genus *Xenosaurus* with nuchal collar straight across middle of neck, not V-shaped; venter without dark markings; light areas between dorsal dark bands whitish, tips of tubercles brownish; lateral fold whitish; a pair of squarish dark marks posterior to occiput; a single, large, bulbous postrostral, wider than long; zygomatic and postorbital ridges in contact through most or all of their parallel length; one row of moderately large supraoculo-orbitals; labiomen-

row extending forward to 1st chinshield and infralabial; maximum number of scales in a transverse row of scales on venter 25-29; lamellae on 4th toe 19-23; most temporal tubercles contacting each other, no more than a few posterior tubercles separated by one row of granules; tubercles in paravertebral rows elongate, flat, slightly larger than lateral tubercles, separated anteroposteriorly from each other by one or two rows of granules; paravertebral rows separated from each other by a distance varying from 2-3 times the length of their tubercles; lateral tubercles of abdomen separated from each other by their own diameter, little more or less; dorsal foreleg and hind leg tubercles mostly in contact with each other, at most one row of granules between them; caudal dark bars solid black above, longer than light tan interspaces, but weakly split and narrower than light interspaces below.

Description of holotype. As in diagnosis; postparietal dark spots dimly continued narrowly forward on either side of the midline to frontal region; collar with two central light areas on either side, almost completely split vertebrally, extending laterally to level of upper edge of tympanum; four broad dark bars on trunk posterior to collar, each of the three crossing the dorsum with numerous small, light central areas, anterior and posterior borders intact, lateral ends open (as in the collar), reaching to but not onto lateral fold; sacral dark band nearly solid black, light central spots much smaller than in other trunk bands; 10 dark bands on tail, all solid black above except for a few very small, central light dots on the basal band; 4th and 5th caudal bands with a few central light dots below.

Postrostral large, contacting both nasals; rostral straight-edged posteriorly; enlarged supraoculars 4-5, separated from supraorbital semicircles by a row of scales as large as most of those lateral to enlarged supraoculars; postorbital and zygomatic ridges in contact behind eye except for one large, dorsally intercalated scale; one row of lorilabial scales below suboculars, strongly keeled; 10-11 supralabials; 10-11 infralabials; labiomenal row extending forward to 1st chinshield and 1st infralabial.

Head length (straight line, to rear edge of tympanum) 23.5 mm, width 19 mm, depth 10 mm; s-v 95 mm; tail 94.5 mm; hind leg 38 mm.

Variation. Most significant variation is discussed under Materials and Methods. There are only two males in addition to the holotype: no. 51441, 87 mm s-v (tail 82 mm), and no. 41956, 78 mm s-v (tail 70 mm). The tail/s-v ratio varies from 0.89 to 1.06. In every specimen the labiomenal row extends anteriorly to the 1st chinshield and infralabial. The tail bands vary from 9 to 13. The scales in the single row between the enlarged supraoculars and supraorbital semicircles are relatively large in all. The transverse rows

on venter, axillary level to preanal area, vary from 35 to 38, the preanal rows from 3 to 5. The smallest and largest specimens, both females, measure 45 (UF 51447) and 104 (UF 51440) mm, respectively.

Etymology. The specific name *rectocollaris* is derived from the Latin *rectus*, straight, and *collare*, collar, and is used as an adjective modifying the generic name. It alludes to the unique shape of the collar in this species, being straight transverse rather than v-shaped. In-as-much as the nuchal mark of other taxa of the genus has often been referred to as a collar, it is expedient that the specific name should designate kind of collar.

Remarks. Color slides of *X. rectocollaris* reveal that the iris in this species is yellowish-orange, not bright red as in *X. g. grandis* from Cuautlapan, Veracruz. Prof. José L. Camarillo R. advises us (pers. comm.) that the iris is yellow in *X. platyceps*.

One of the members of the 1981 field trip conducted by JBI, C. R. Smith, reported 28 August 1981 (in litt.), while a student at the University of Texas, that "while holding the *Xenosaurus*, one gave birth to a single huge baby. On dissecting one for tissues in Michigan, I found a fairly advanced ovum...these one-lizard litters may be of interest," especially since Fritts (1960) and Alvarez (1982) indicated a litter of size of four to seven in Cuautlapan *X. g. grandis*, three in Chiapas "*X. rackhami*." However, dissection of the five mature female paratypes of *X. rectocollaris* (84-104 mm s-v; immatures 45-68 mm s-v) reveals one with two large eggs (15-17 mm) in one oviduct (the other oviduct missing at the present time, presumably having been removed for study), the remainder all with ovarian eggs only, the largest ones numbering 3-4 in each ovary and measuring 1.5-2 mm in diameter. It is rather surprising that such variation in embryonic development should exist among animals all collected on one day, from small ovarian eggs to large oviductal eggs to full parturitional maturity. At least it is obvious that the litters of *X. rectocollaris* are not limited to single neonates; Alvarez (1982:133) provided a possible explanation for such a misimpression by the comment that in "*X. rackhami*" (translated) "...the females give birth to three young, not all at the same time but over a period of four to six days."

Other members of the herpetofauna sharing the semiarid habitat of *X. rectocollaris*, and found at the same time by JBI's party in 1981, constitute a peculiar mixture of typically more mesic, forest-dwelling taxa (e.g. *Sceloporus mucronatus aureolus*, *Crotalus i. intermedius*), as are other species of *Xenosaurus*, and typically more xerophilic species (*Sceloporus megalepidurus pictus* (subspecies fide Dasmann and Smith, 1974), *S. s. spinosus*). The strictly plateau species *Toluca lineata varians* was also found at the bottom of the hill where the *Xenosaurus* were taken.

Acknowledgments

We are much indebted to JBI's field companions (Terry Leitheuser, Ron Magill, Peter A. Meylan, Paul Moler, C. R. Smith) for aid in collecting material at the type locality of *X. rectocollaris*; to David L. Auth, Florida Museum of Natural History, as well as John Simmons, University of Kansas Museum of Natural History, and Dr. Shi-Kuei Wu, University of Colorado Museum, for permission to study material under their care; and to Dr. William M. Lewis, Chairman of the EPO Biology Department, University of Colorado, and Dr. Shi-Kuei Wu, for provision of vital facilities for research. Fieldwork in Mexico was supported by NSF DEB 8005586. The material from the type locality was collected under a permit issued to Peter Meylan by the Dirección General de la Fauna Silvestre, Subdirección de Aprovechamientos Faunísticos.

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Appendix

Specimens examined of *Xenosaurus*, other than *X. rectocollaris*, are as follows.

X. g. grandis. VERACRUZ: Cuautlapan (KU 105840-5; UCM 48453-6).

X. g. agrenon. OAXACA: Santa Rosa, nr Lachao, District of Juquila (UCM 52518, 52607-8); Río Sal, nr Lachao, District of Juquila (topotypes; UCM 41148-56, 44475-8).

X. g. rackhami. CHIAPAS: Cerro del Sumidero, 10.7 mi N Tuxtla Gutiérrez (UCM 19028).

X. newmanorum. SAN LUIS POTOSI: 4.1 mi E Xilitla, 2650 ft (UF 25006).

X. platyceps. TAMAULIPAS: 12.4 mi SW Río San Marcos (Cuidad Victoria), Hw 101 (UF 42025-32).

X. sp. nov. OAXACA: Cerro Acaltepec, San Juan Acaltepec, District of Yautepec (UCM 44463-74).

X. sp. nov.? OAXACA: Vista Hermosa, 1600 m, municipality of



Fig. 1. The type locality of *X. rectocollaris*. 8 km E Chapulco, Puebla, Mexico.

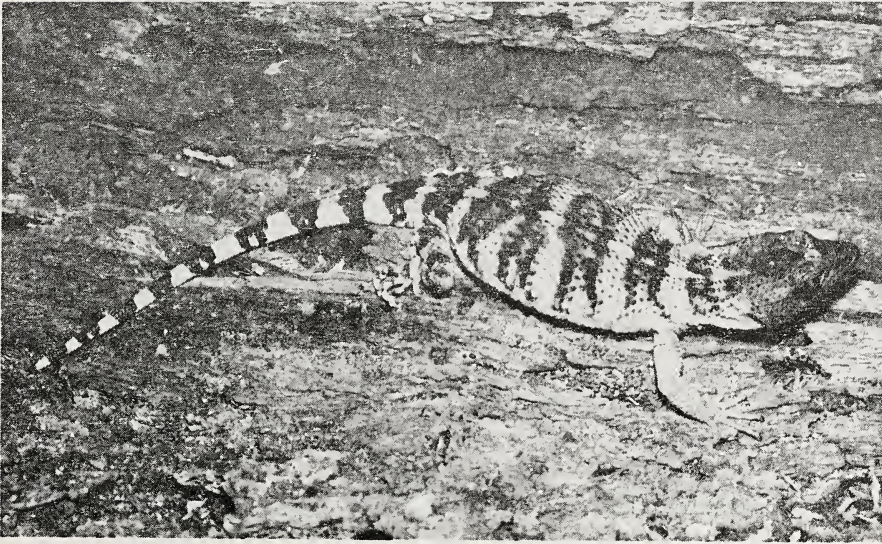


Fig. 2. A female paratype (UF 51440), 104 mm s-v, of *X. rectocollaris*.

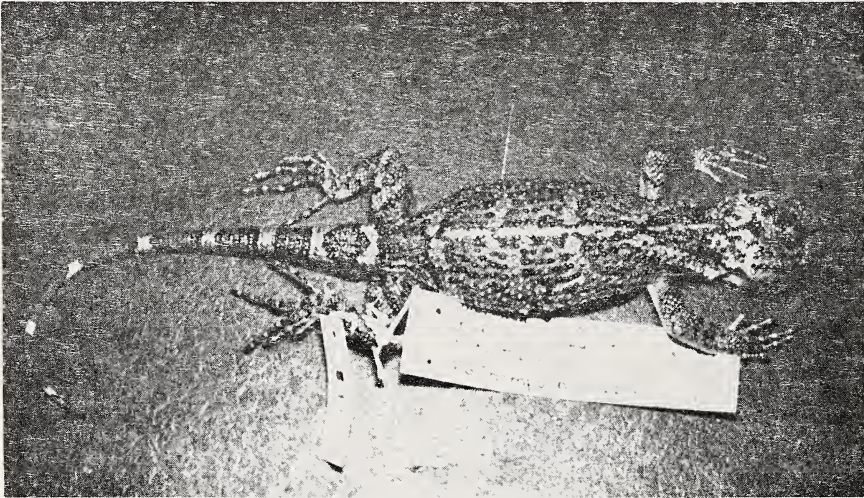


Fig. 3. *Xenosaurus newmanorum*, UF 25006, male, 96 mm s-v, showing the large, V-shaped, posteriorly situated nuchal mark.

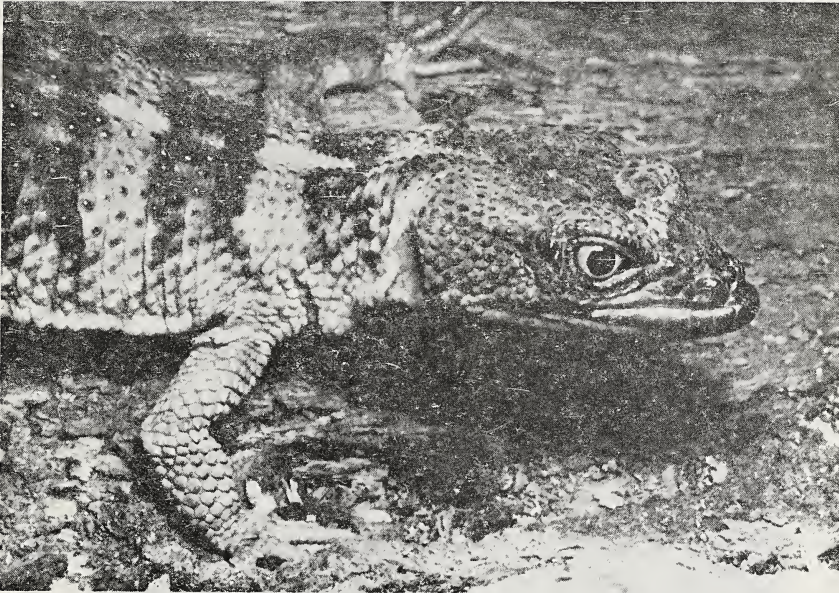


Fig. 4. The same animal as in Fig. 2, showing the tight juxtaposition of zygomatic and postorbital ridges, and the large, median postrostral.

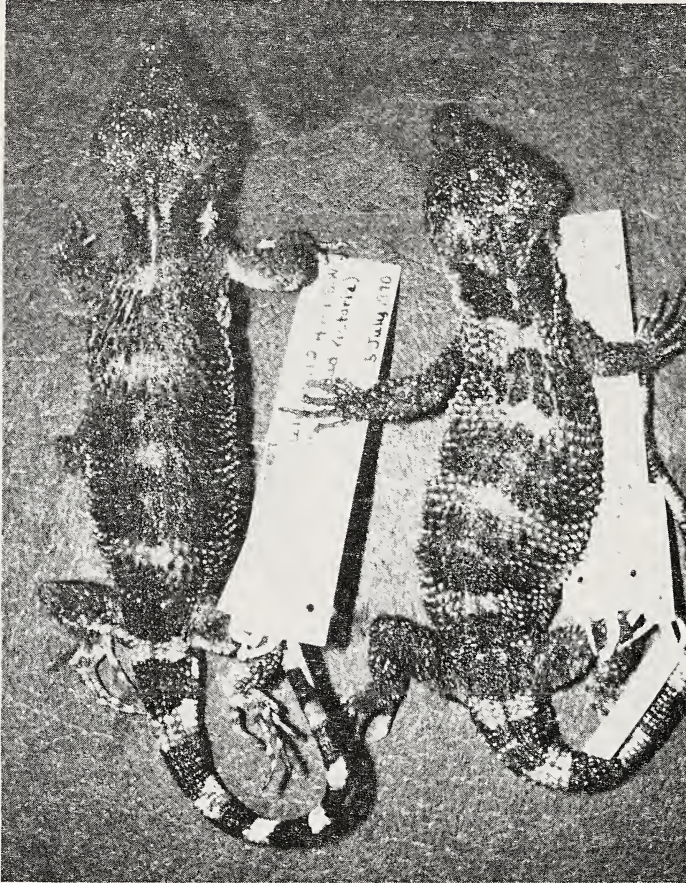


Fig. 5. *Xenosaurus platyceps*, showing the large and profuse tubercles on body and limbs. UF 42048 and 42032, both males, 106 mm s-v.

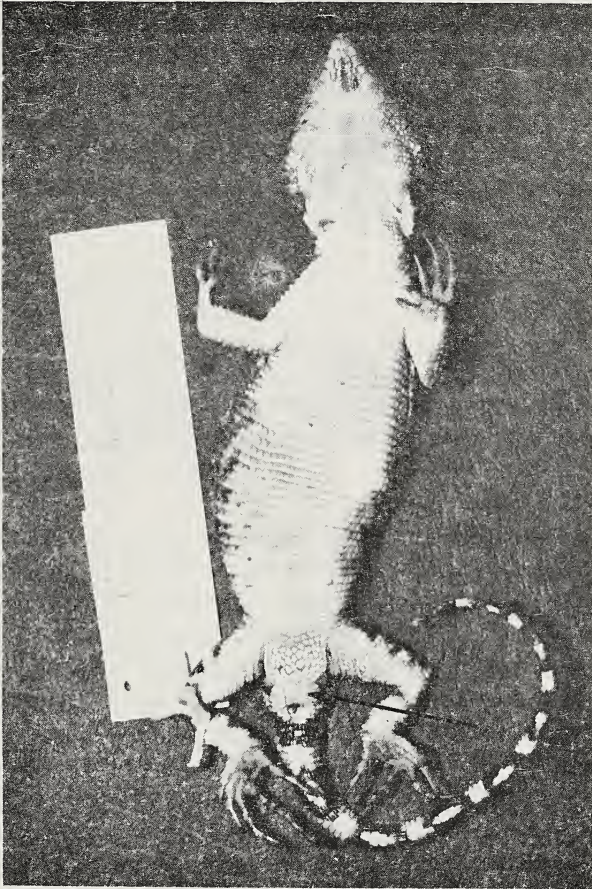


Fig. 6. *Xenosaurus platyceps*, showing the nearly immaculate venter (marked only on the sides), and the postanal platform (arrow). UF 42025, female, 87 mm s-v.

Comaltepec (KU 87437; UCM 49320, 52482, 52487-8).

Addendum

Received too late to be incorporated into the preceding text, but here regarded as a paratype, is UF 86763, from 3 km NE Lagunas San Bernardino, Puebla, Mexico (within 20 km of the type locality), 18°36'06" N, 97°17'25"W, 2500 m, found in a limestone rock pile 26 Oct. 1992 by E. L. Reiser and F. G. Thompson. It is half grown (67 mm s-v, tail 61 mm), male (not dissected, judged from scale shape as described in the text), and conforms fully with the diagnostic character-states of the species, including color and pattern; there are 26 (max.) contiguous ventrals across the abdomen, 34 rows axilla to groin, and the 4th toe lamellae are 23-23.

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OBSERVATION AND REVIEW OF THE NESTING AND EGG-LAYING OF *CORYTOPHANES CRISTATUS* (IGUANIDAE).

Marco A. Lazcano-Barrero and Eleuterio Gongora-Arones

The casque-headed iguanid lizard *Corytophanes cristatus* is found from the state of Veracruz, México to Colombia (Peters & Orejas-Miranda 1986; Villa, *et al.* 1988) inhabiting prime tropical rain forest (Stuart, 1948 and 1958; Duellman, 1963; Lieberman, 1986; Bock, 1987; Lazcano-Barrero, *et al.* 1992) at elevations below 1000 m.a.s.l. (Johnson 1989; Campbell & Vannini, 1989).

Due to its apparent low population-densities, arboreal habits, cryptic behavior, coloration and morphology (Davis, 1953; Stuart, 1958; Andrews, 1979; Bock, 1987), the ecology and life history of this species, as well as the other two members of the genus *Corytophanes*, remains poorly known, as indicated by Lang (1989) in a recent review of the basciliscine iguanians. The only published information concerning nesting and egg laying has been that of Ream (1965) and Bock (1987).

As part of an herpetofaunal inventory of the Selva Lacandona, Municipio de Ocosingo, Chiapas, México (Lazcano-Barrero, *et al.*, 1992), on July 27, 1984, an adult female *C. cristatus* (TL = 373 mm, SVL = 119 mm) was collected, by MALB and EGA, while covering her hole nest (depth 54 mm; width 43 mm) in a slope (inclination 50 to 60 degrees) on a path (width ca. 40 cm) in a tropical rain forest, described by Breedlove (1973), at 1250 hrs., near Laguna Jalisco (16°44'N, 91°11'W; 400 m elev.), after a prolonged (14 hour) and heavy rain. The nest contained a clutch of 7 eggs (Figure 1). The number and average measurements of these eggs (Table 1) are above those previously reported by Ream (1965; N = 6; weight = 2.01 g; Length = 23.0 mm; Width = 12.4 mm) and Bock (1987; N = 5; length = 20 mm).

The specimen (Figure 2), unfortunately lost, was deposited in the Instituto Nacional de Investigaciones Sobre Recursos Bióticos, herpetological collection (INIRB-035), at present under custody of the Instituto de Historia Natural del Estado de Chiapas.

When detected, the female became cataleptic. Only after capture did the lizard become active, repeatedly attempting to bite the hand that held it, a behavior previously documented by Davis (1953) and Bock (1987).

The lizard had dirt on top of its casque, supporting Bock's (1987) observations that this structure is actively employed by females in nest excavation, a behavior also described in *Corytophanes hernandezi* (Perez-Higareda, 1981) the only other oviparous species of the genus. After being seized, the female defecated; the peculiar scat (Figure 3) contained remains of an orthopteran and a lepidopteran larva. These prey items agree with the specialized diet (large arthropods) reported by Andrews (1979) for this species in Costa Rica and Panama.

Available information on the reproduction of *C. cristatus* is summarized in Table 2, and indicates that the species nests on compact soils devoid of leaf litter, within prime tropical rainforests, laying 5 to 7 eggs. Although more eggs could perhaps be laid as evidenced by a specimen collected by Duellman (1965), which contained eight fully developed ova. A positive correlation between clutch size and female length (SVL) is also expected, as has been documented for other iguanid lizards (Ford & Seigel, 1989). The species nests between June and August, during the summer peak of the rainy season. According to Ream (1964), the known incubation period, under captive conditions, is five months for a single hatchling (TL = 75 mm; SVL = 35 mm).

Although detection of nesting females in rainforest trails may constitute a bias, at present nesting away from trails can not be determined from published sightings. Nevertheless it is clear that the species nests on open ground.

We hypothesize that among rainforest iguanids, nest excavation on areas free of leaf litter may substantially reduce detection of females by potential predators, by eliminating the sound of leaf litter removal and reducing the time and energy required during the nesting excavation process, a period when the arboreal, cryptic, iguanid females of *C. cristatus* are more vulnerable to predators. Moreover, use of rainforest trails (compacted soil, no leaf litter) by *C. cristatus* may also reduce detection of eggs by terrestrial, leaf litter, and fossorial predators.

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TABLE 1.- WEIGHTS AND MEASUREMENTS OF
Corytophanes cristatus EGGS.

EGG No.	WEIGHT g	LENGTH mm	WIDTH mm
1	2.2	22.0	13.0
2	2.6	23.0	13.2
3	2.7	23.5	14.0
4	2.6	24.0	13.5
5	2.6	23.5	13.0
6	2.8	24.0	13.9
7	2.7	24.6	13.0
X	2.6	23.5	13.4

TABLE 2.- SUMMARY OF REPRODUCTIVE INFORMATION OF *C. cristatus* .

FEMALE SVL (mm)	CLUTCH SIZE	DATE/ ACTIVITY	HABITAT	LOCALITY	SOURCE
125	(a)	JUNE 28	RAINFOREST	CHINAJA ALTA VERAPAZ GUATEMALA	DUELLMAN, 1965
120	5 (b)	JUNE 25 NESTING	TRAIL PRIMARY RAINFOREST	RARA AVIS HEREDIA COSTA RICA	BOCK, 1987
n. d.	n. d.	n. d. NESTING	TRAIL PRIMARY RAINFOREST	LA SELVA COSTA RICA	BOCK, 1987
119	7	JULY 27 NESTING	TRAIL PRIMARY RAINFOREST	SELVA LACANDONA CHIAPAS MEXICO	PRESENT
107	6	FEB 5(c) NESTING	CAPTIVE	BARRO COLORADO PANAMA	REAM, 1964

- a.- Eight ova within female, with an average diameter of 11.1 mm.
 b.- The clutch size may have been higher since the female was captured and released on site, without determining if there were additional eggs in the oviduct.
 c.- Eggs laid in captivity by a female that had been isolated for five months and 10 days, mating took place before August 27 the previous year when the specimen was captured.

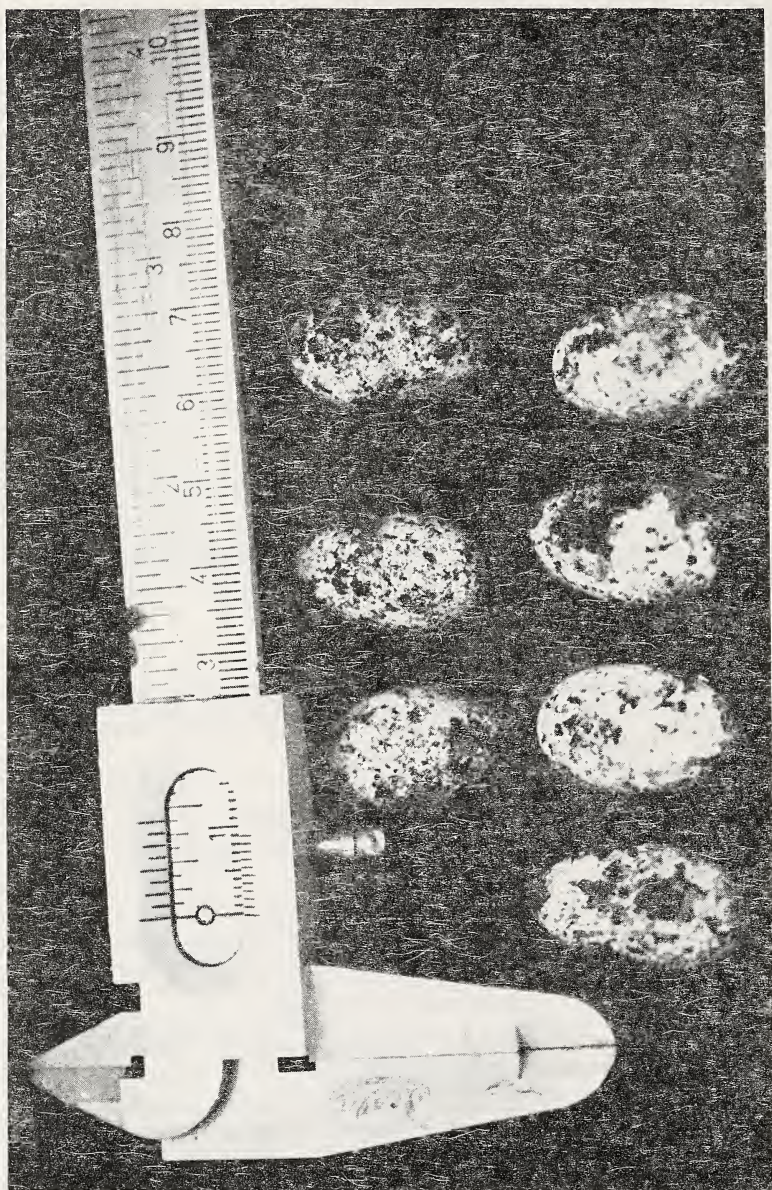


Fig. 1. Eggs of *C. cristatus*, (photographed by MALB).



Fig. 2. Adult female *Corytophanes cristatus* (photographed by MALB).

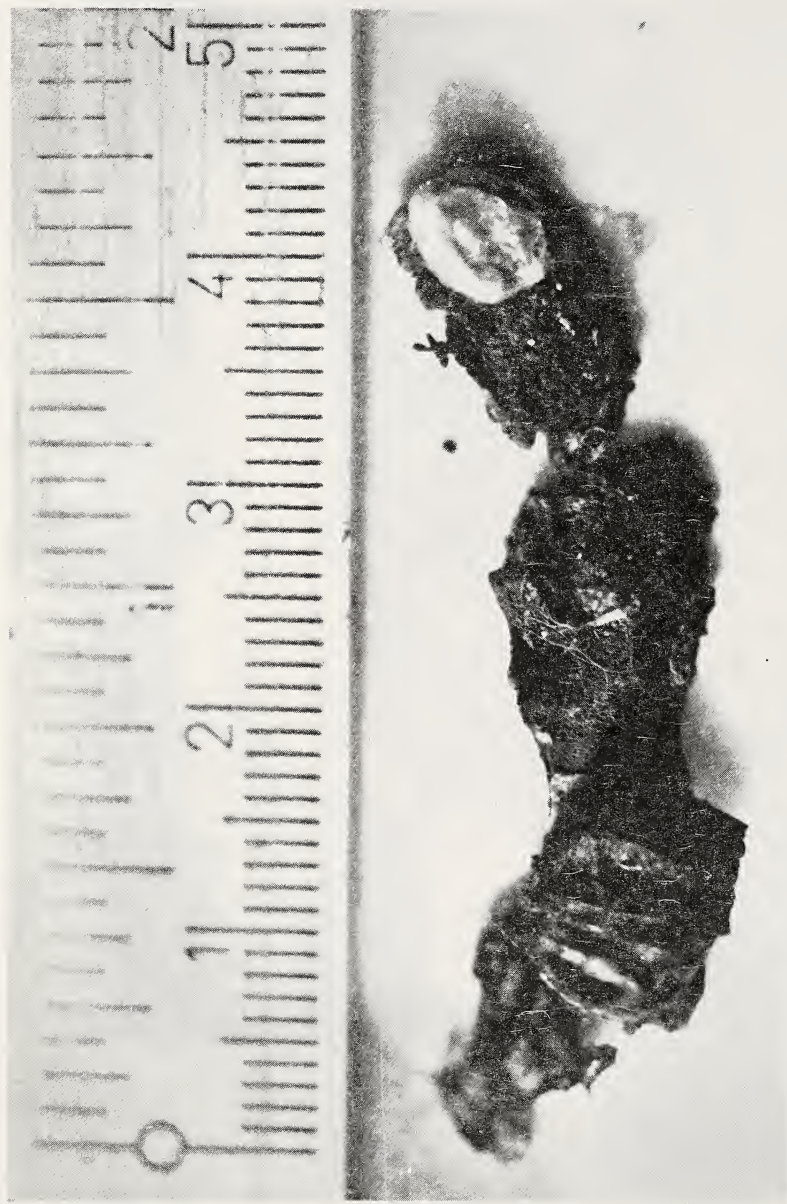


Fig. 3. Scat of *C. cristatus* (photographed by MALB).

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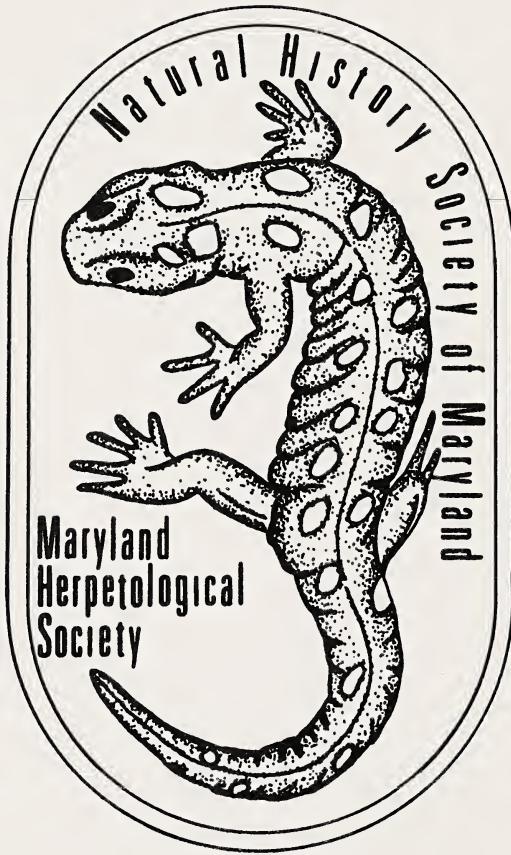
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30 SEPTEMBER 1993

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Volume 29 Number 3

September 1993

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DROMICUS GIGANTEUS JAN (REPTILIA: SERPENTES) IS A NOMEN NUDUM

Hobart M. Smith, James R. Dixon and V. Wallach

Although treated by Dixon (1981, 1989) as an available name having priority over *Dromicus ornatus* Garman (1887) (now *Liophis ornatus*), *Dromicus giganteus* Jan (1863) is a *nomen nudum* and therefore has no nomenclatural status. No action by the International commission on Zoological Nomenclature is necessary to protect the name *Liophis ornatus* (Garman).

In commendable deference to the long-established goal, in response to a vital need, of the International Code of Zoological Nomenclature to safeguard nomenclatural stability—a deference that should be more widely practiced—Dixon (1981) chose to maintain existing nomenclatural usage when, in monographing the eastern Caribbean snakes of the genus *Liophis*, he discovered that a never-used name he considered available, *Dromicus giganteus* Jan (1863:67), antedated the long-accepted name *Dromicus ornatus* Garman (1887:281).

Under those circumstances, the security of the latter name, in the combination *Liophis ornatus* since Dixon's 1981 review, would rest strictly with the willingness of other workers to resist application of the Principle of Priority that, under the Code, would require use of Jan's name unless the International Commission on Zoological Nomenclature was requested to intercede through its plenary powers. On the contrary, any nomenclatural fundamentalist, herpetologist or not, could insist upon using the earlier name.

So far that has not happened. For example, the most recent monograph of the West Indian herpetofauna (Schwartz and Henderson, 1991:625) still uses Garman's name. However, such principled maintenance of the status quo is by no means assured, hence a reexamination of the situation was undertaken.

Much to our relief, a critical evaluation of Jan's 1863 proposal of *Dromicus giganteus*, in the light of the 1985 edition of the Code, leaves no question that it actually is a *nomen nudum*, and therefore is not available in nomenclature. Article 12(a) explicitly requires that to be available any new scientific name published before 1931 "must have been accompanied by a

description or a definition *of the taxon that it denotes*" (italics ours). True enough, Jan (1863:66-67) gave a partial key to the members of *Dromicus*, but *D. giganteus* was in a group of nine species, all having a single anterior temporal, 17 scale rows and one loreal. The species of that group were not distinguished from each other, hence there is no characterization of that particular taxon (*D. giganteus*)—only to a group of species for which no collective discriminatory name was given.

Since *D. giganteus* is clearly a *nomen nudum* and unavailable under the Code, the specimen on which it was based is not a holotype. Article 12(c) makes it clear that mention of a specimen does not comply with the requirement of Article 12(a). Furthermore, under Article 11(e) Dixon's interpretation of *D. giganteus* as available, and his characterization of it, does not make that name available even of his authorship because he did not adopt it as a valid name.

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THE DATE OF PUBLICATION OF *JALTRIS* COPE (REPTILIA: SERPENTES)

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The earliest publication date of the nominal genus *Jaltris*, an unjustified emendation of *Ialtris* Cope, 1862, is in Cope (1863), not in any of several other works as has been averred in various publications. As an available name, although currently invalid, *Jaltris* Cope has precedence over any other generic name of identical spelling and later date, and could be used as a replacement name if needed.

The generic name *Jaltris* has long been of uncertain attribution and date, although universally accepted as an emendation, valid or not, of *Ialtris* Cope (1862: 73). Although Cope used the spelling *Jaltris* in several publications following the appearance of the volume containing his description of *Ialtris* (1879, 1886, 1887, 1894, 1895, 1900), he never cited the source of the emendation, leading Cochran (1941) to attribute *Jaltris* to his earliest publication using that name (Cope, 1879). In 1900 Cope actually used both spellings: *Ialtris* on p. 698, presumably a lapsus, and *Jaltris* on p. 1091, but otherwise he consistently used the latter spelling in reference to its biotaxon.

Marschall (1873: 50) has commonly been accepted as the first explicitly to list *Jaltris* as an emendation of *Ialtris* Cope, but again without giving a source. Therefore Scudder (1882b: 163) assumed that Marschall created the emendation, although in error; Scudder erred also in placing *Jaltris* in the Lepidoptera, although he listed *Ialtris* Cope (1862) correctly in both works (1882a: 171; 1882b: 159). His action led Schulze et al. (1932: 1707) and Williams and Wallach (1989: 79) likewise to credit Marschall (1873) with the emendation. Neave (1939-1950), oddly, does not list *Jaltris*.

Outside of literature-recorders, Werner (1924: 131) is the only author except Cope to have used *Jaltris* as a valid name, but again without citation of source.

Although never so noted before now, Cope himself created the emendation. It is found in the "Errata and Addenda" section of volume 14 of the Proceedings of the Academy of Natural Sciences of Philadelphia - the same one in which his description of *Ialtris* appeared. In that section, p. 594, is the entry "p. 73, line 34, for *Ialtris* read *Jaltris*."

Original spellings changed in publisher's "corrigenda" (Art. 33(b)(i)) are, under Art. 32(c)(ii), incorrect original spellings, and as such are to be corrected (Art. 32(d)), the replaced name then having no separate availability as of the corrected work. That interpretation would, in the present case, make *Jaltris* the correct name for the genus universally (since 1924) known as *Ialtris*, and the latter name unavailable as of Cope (1862).

On the contrary, however, Art. 32(c)(ii) requires that, for that rule to apply, corrigenda must appear "in the original publication itself," which *Jaltris* Cope (1863) did not do. The section of the Proceedings containing Cope's original description of *Ialtris*, according to Nolan (1913: xlii), appeared at some time before May 27, 1862, whereas the section containing the "Errata and Addenda" appeared at some time between Jan. 12 and Feb. 26, 1863. Accordingly, under the current Code, *Jaltris* actually is an unjustified subsequent emendation of *Ialtris*, originating with Cope (1863). As such it is an available although currently invalid name. It has precedence over any other generic name of identical spelling and later date, and could be used as a replacement for *Ialtris* were it needed, e.g. through discovery of junior homonymy. Had the two names been published in the same work it would have been a different story.

However unfortunate this outcome may be from the standpoint of Cope's intent, it is most fortunate relative to nomenclatural stability, inasmuch as the spelling *Ialtris* has been regularly accepted, with the cited exceptions, at least since Garman (1887: 284), in dozens of works by dozens of authors.

We here note another citation of *Jaltris* that is of ambiguous significance. As pointed out by Williams and Wallach (1989: 79), Troschel (1863: 635), in his listing of the herpetological literature of 1862, cited "*Jaltris* Cope nov. gen. Proc. Philadelphia p. 72," taken by Williams and Wallach as an "Error or emendation of *Ialtris* Cope." Since only works published in 1862 were covered in this compilation, and only p. 72 was cited, it is quite possible that Troschel himself independently created the emendation. Even if so, it clearly must have appeared long after Cope's emendation, as indicated by the early publication of the latter (between Jan. 12 and Feb. 26, 1863), and the probable late appearance of Troschel's article (suggested by its advanced pagination, pp. 620-641). On the other hand, because of the late date of appearance of the latter, Troschel may indeed merely have adopted Cope's emendation without citing its source precisely (p. 594). The issue of which alternative is correct is moot, however, since Cope's emendation can be accepted as having appeared earlier than Troschel's work.

Acknowledgment

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A REVIEW OF THE MEMBERS OF THE *SCELOPORUS VARIABILIS* LIZARD COMPLEX

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In the absence of convincing evidence of intergradation with *Sceloporus variabilis*, and because of near parapatry and sympatry, *S. teapensis* is regarded as a full species. It is found to be extensively sympatric with *S. smithi*, which is therefore also regarded as a full species. *S. v. olloporus* is revived for the subspecies extending from Guatemala to Costa Rica. The range of *S. teapensis* splits that of *S. v. variabilis* into three completely dichopatric enclaves: (1) southern Tamaulipas to southern Veracruz; (2) the coast of Tabasco; and (3) Pacific slopes of Oaxaca east of the Isthmus of Tehuantepec through southern Chiapas and southwestern Guatemala. *S. smithi* evidently hybridizes occasionally with *S. teapensis*, and may well do so also with *S. v. variabilis* in southeastern Oaxaca. Several characters not previously explored are surveyed, and a key to the five recognized taxa of the complex is provided. Urophely (a new term) is reported for the first time in the Sceloporinae.

The correct taxonomic rank for the taxon first named *Sceloporus teapensis* by Günther in 1890 has been uncertain throughout most of its history. Boulenger (1897) accepted it as a valid species, although erroneously regarding Bocourt's (1874) *S. cupreus* as an earlier name for it. Even then Boulenger noted that it might be referable to *S. variabilis* Wiegmann (1834), presumably as a distinct subspecies. Its more recent history begins with maintenance as a full species, under its proper name *S. teapensis*, by Smith (1936, 1939), but suggestions later by various workers that subspecific rank under *S. variabilis* might be correct culminated with a formal adoption at that level by Cole (1978), based on morphological and karyological studies of the entire *variabilis* group, although the misinterpretation of a critical series from Tabasco was a major factor in his conclusion. In 1982 Sites and Dixon supported Cole's conclusion in a highly sophisticated analysis of external variables in 1408 specimens representing the entire species *S. variabilis* as they then understood it. The same arrangement appeared in Mather and Site's (1985) review of that species in the American Catalog, and most subsequent works have conformed with that arrangement, in which four subspecies are recognized; *S. v. marmoratus* Hallowell (1852), *S. v. smithi* Hartweg and Oliver (1937), *S. v. teapensis* and *S. v. variabilis*. Smith's (1937, 1939) analyses differed not only in ranking *S. teapensis* as a full species but also in segregation of the southern-most enclave of *S. variabilis*,

in Central America, as a separate subspecies, *S. v. olloporus* Smith (1937).

Although the review by Sites and Dixon (1982) involved a total of 38 characters, their taxonomic conclusions were based largely upon two essential characters: dorsal scale count and number of femoral pores. They did not consider number of postrostrals, and found no basis for special emphasis on presence or absence of a subnasal (utilized by Smith (1939) in differentiating *S. teapensis* from *S. variabilis*) or number of longitudinal rows of dorsals. Guillette et al. (1983) reported an additional character of possible use in distinguishing the latter two taxa - pigmentation of the testicular peritoneum. The present study was undertaken to assess the utility of these variables to the understanding of the relationships of the taxonomic populations of the *S. variabilis* complex, with special emphasis upon "*S. teapensis* Günther".

Materials and Methods

A total of 1384 specimens was examined, without screening for sample size, and in part selected with special attention to any evidence of geographic range overlap of taxonomically distinct populations. In that context even single specimens from given localities can be of great significance. All specimens of the complex were examined in the collection of the University of Kansas Museum of Natural History (KU; 686) and the University of Colorado Museum (UCM; 355); and selected specimens in the American Museum of Natural History (AMNH; 5), University of Michigan Museum of Zoology (UMMZ; 6), Museo de Zoología, Facultad de Ciencias, U.N.A.M. (MZFC; 25), Field Museum of Natural History (FMNH; 74), University Of Illinois Museum of Natural (UIMNH; 54), Museum of Comparative Zoology (MCZ; 2), James Ford Bell Museum of Natural History, University of Minnesota at Minneapolis (JFBM; 216), and the University of Texas at Arlington Vertebrates Collection (UTA; 151) (acronyms from Leviton et al., 1980). In addition, Dr. Jack Sites kindly made available to us all of his data on 1408 specimens, many not duplicated in our materials, especially the 486 in the Texas Cooperative Wildlife Collection (TCWC). The KU, UCM, and UTA collections constituted the heart of our study; other specimens were for the most part selected to clarify specific questions in critical areas.

Inasmuch as Sites and Dixon (1982) dealt thoroughly with the geographic variation in dorsal scale counts and number of femoral pores (their Figs. 2, 3), we concluded that nothing could be gained by repetition of that work, although both character-states were recorded on certain critical specimens. In addition, we agreed that data on most other characters are "of little utility in assessing patterns of geographic variation" (Sites and Dixon,

1982: 15). In several characters, however, some in their list and some not, we found significant geographic variation, as follows.

1. *Nuchal (nape) rows.* The sizes of the dorsal, ventral and lateral scales on the body in *Sceloporus* are, to a considerable degree, proportional. Certainly their sizes are not as independent of each other as in *Anolis* and its allies, but neither are they exactly correlated. The dorsal body scale size, however, appears to vary as a unit, and thus in the *S. variabilis* complex is reflected more or less equally well by (1) the usual head-tail count and by (2) a transverse count at those points on the body where dorsals and laterals are sharply differentiated from each other.

Two such points exist: in the nuchal and sacral regions. In both regions, the most lateral dorsal scales are distinctly larger than the adjacent laterals, and are not basically uniplanar but describe an obtuse angle marking the junction of dorsal and lateral body surfaces. The nuchal (or nape) count, as we recorded it, is the minimum transverse count between head and foreleg level, usually near the middle of the neck, and including the most lateral row of angular dorsals on each side. The range of variation in the complex is from 9 (*S. teapensis*) to 18 (*S. v. marmoratus*), forming a taxonomically stepped S-N cline, few rows to numerous ones, between those two taxa, but a N-S cline elsewhere.

2. *Sacral (rump) rows.* Similarly, as we recorded it, the sacral (or rump) count is the minimal count made transversely of the enlarged dorsals at the level of the hind legs. The dorsal scale rows converge in the sacral region, hence it is necessary to limit the area where the minimal count is made. The transverse line counted could not, in our procedure, include any scale lying in any part at or posterior to the midline between the anterior and posterior levels of the hind leg insertion. Total variation in the complex is 7 (*S. teapensis*) to 15 (*S. marmoratus*).

3. *Lateral abdominal scales.* The scales that we have observed to vary in size inter-populationally, more or less independent of the size of the dorsal scales, are those on the sides of abdomen and neck. Unfortunately we have found no way to quantify the differences observed, hence they remain subjective and useful primarily in cases in which objective criteria leave doubt of identity.

In *S. teapensis* the scales anterior to the immediate groin area are relatively large, little reduced in size compared with the median lateral scales (Fig. 1). In *S. variabilis* and *S. smithi*, on the contrary, those scales are very small, little larger than those at the groin (Fig. 2).

4. *Lateral nuchal scales.* The posteroventral free edge of the lateral nuchal fold bears enlarged, acuminate, keeled scales contrasting sharply in size and shape with the scales lining the lateral nuchal pocket which is covered by the lateral nuchal fold. In *S. teapensis* the external scales between the series on the edge of the lateral nuchal fold and the dorsal nuchal scales are of about the same size as those on the edge of the fold, not reduced in size (Fig. 3). They are little smaller than the scales in the lateral row of dorsal nuchals. On the contrary, in *S. variabilis* and *S. smithi* the lateral nuchals are markedly smaller than the dorsal nuchals or the scales on the edge of the lateral nuchal fold (Fig. 4).

5. *Lateral fold.* The median lateral scales in *S. smithi* are so small—little larger than the scales in the borders of the axillary and groin regions—that, at least in preserved specimens, the larger scales dorsal and ventral to the small median ones tend to encroach upon the latter, raising the skin bearing the small scales into a longitudinal ridge (Fig. 5). All preserved specimens checked for this character possess the ridge at least weakly developed. Whether it is evident in live specimens is unknown. In other related taxa no such ridge occurs; the median lateral scales are presumably too large to form a ridge, and there is a greater contrast in size between them and the border axillary and groin scales.

The lateral ridge appears to be structural, because it is positioned and shaped the same in all specimens. It lies rather high on the sides, distinctly nearer the dorsum than the venter, does not reach the groin, but curves ventrad anteriorly to end in the axilla close to the ventral insertion of the foreleg. It disappears completely with tension on the skin ventral to it, but its invariable position and shape suggests that it depends on some histological irregularity presumably of genetic origin. It does not occur even in *S. v. marmoratus*, which has equally small body scales.

6. *Canthosubnasals.* In the *S. variabilis* complex, either two or three scales extend along the canthal ridge, from the superciliaries to below the nasal scale. In previous works (e.g. Sites and Dixon, 1982), it was assumed that if only two scales are present along the entire ridge, it is the subnasal that is absent, because often it is extremely small where three scales are present. However, the subnasal in some specimens is large, even when three occupy the ridge. It is not certain that reduction of the total to two is always a result of loss of the subnasal rather than of the anterior canthal. We therefore here adopted the policy of referring to all of the scales collectively as canthosubnasals, of which there always were two or three. *S.*

teapensis typically has only two, varying from 61 to 86% in different populations (x 74%), whereas no other populations of the *S. variabilis* complex has two in more than 14% except for *S. v. marmoratus* with 31%.

Care has to be taken to exclude from the canthosubnasal count any of the lorilabials (loreolabials of Stuart, 1971), which form a continuous series from below the subocular to the nasal.

7. *Postrostrals*. As pointed out long ago by Smith (1937), the number of postrostral scales in populations of Nicaragua and Costa Rica is often reduced to two from the normal four. We explored variation in that number throughout the complex, because it is a character often constant in a whole group; two regularly occur, for example, in members of the *scalaris* and *siniferus* group, whereas four is typical in most other groups of the genus. Some care has to be taken to avoid confusion of the postrostrals with the anterior lorilabials. The total variation found in this complex is 2-6; counts of 5 or 6 are rare and anomalous.

8. *Dorsal pattern*. The dorsal pattern is essentially the same throughout the complex, with the exception of *S. smithi*. In all populations except the latter, the ground color is gray-brown, with a pair of dorsolateral stripes, not sharply delimited, varying from a little to distinctly lighter than but of much the same hue as the ground color. A series of dark spots or marks parallels each light stripe near its medial edge, and on the sides of the abdomen near the lateral edge of the stripe. Juveniles and females exhibit more distinct spotting than adult males.

In *S. smithi*, on the contrary, the area between the dorsolateral stripes is nearly or quite uniform, dark chocolate brown or black; the dark spots of other populations are not or but faintly evident. The two light stripes are sharply defined and brilliantly distinguishable, essentially white in color, not dark-pigmented. The pattern is one of striking contrast individually and in comparison with other populations of the complex; it occurs in both sexes and at all ontogenetic stages.

9. *Semeions*. The gular and abdominal semeions (color patches; Smith et al., 1991) vary to such an extent that we have observed no populational differences, except for occurrence of weak abdominal semeions in adult female *S. smithi*. They are rarely evident in *S. v. variabilis*.

10. *Tail color.* The small juveniles of *S. smithi* have a conspicuously light, pink tail, which at maturity attains a coloration like that of the body. Presumably the pink tail serves much the same function - diverting the attention of predators from a vital to a non-vital part - as in many skinks. It is, however, the only instance of such *urophely* (Greek *oura*, tail, and *phelos*, deceptive) known to occur in *Sceloporus* or any other *Sceloporinae*.

11. *Carinal ridges.* In *S. smithi* the keels on the dorsal trunk scales are particularly well defined and so nearly perfectly aligned that they form conspicuously continuous ridges. They are not equally as prominent in other populations of the complex.

12. *Size.* *S. v. marmoratus* is by far the smallest taxon of the complex, reaching a maximum s-v length of only 58 mm, and infrequently reaching 50 mm or more (16%). All other taxa reach a maximum somewhat exceeding 70 mm; 78 mm is the maximum record (*S. smithi*).

13. *Testicular peritoneum pigmentation.* Guillette et al. (1983) recorded that no testicular pigmentation was found in 50 male *S. teapensis*, whereas it was observed to occur asymmetrically only on the left testis in 139 (35%) of 398 male *S. variabilis* representing all subspecies. However, the absence of pigmentation in 65% of *S. variabilis*, and its disappearance outside of the breeding season, render the character virtually useless taxonomically. It was not considered important in our study, and was not recorded.

Results

Overview. As indicated in the accompanying key, all of the characters precedingly listed, except for no. 13, exhibit distinct geographic variation importantly supplementing the already well-established geographic variation in dorsal scale count and number of femoral pores. Utilizing all of these features, few problems were encountered allocating individuals or local populations to their proper taxon as here recognized.

Initially, our primary concern was the taxonomic rank of Günther's *S. teapensis*, because of its history of treatment as both a separate species and a subspecies of *S. variabilis*. All other taxa described in the past as subspecies of *S. variabilis* were initially assumed to be correctly accepted or

rejected at the level as concluded by Sites and Dixon (1982). As the study expanded little by little, it was therefore a great surprise to discover that at least one more of the subspecies, other than *S. teapensis* (*S. smithi*), is definitely a separate species, and that *S. v. olloporus* is a valid subspecies.

Nevertheless, as indicated by the accompanying map (Fig. 5), *S. teapensis* by its central position geographically holds the key to the entire complex. Its range splits the populations commonly referred (e.g. Sites and Dixon, 1982) to *S. v. variabilis* into three parts, here termed enclaves, apparently completely separated from each other. The Northern Gulf enclave extends from southern Tamaulipas approximately to the Río Papaloapan in lowlands (farther south in uplands, at least to the Sierra Juárez). In the lowlands southeastward *S. teapensis* replaces *S. v. variabilis*, and extends to the coast eastward about to the Río Coatzacoalcos, thence across the base of the Yucatán peninsula to Belize, and southward to central Guatemala on the east, northeastern Oaxaca on the west, including southern Tabasco and northern Chiapas. The southern central and southwestern parts of the Isthmus of Tehuantepec is occupied by *S. smithi*. The ranges of those two species completely separate the Northern Gulf enclave of *S. v. variabilis* from the populations here called the COG enclave (an acronym for Chiapas, Oaxaca and Guatemala), which is limited to Pacific slopes of Oaxaca east of the Isthmus of Tehuantepec, southern central and northeastern Chiapas, and southwestern Guatemala.

The third isolated population, here termed the Southern Gulf enclave, was first discovered, so far as we are aware, by Dr. Thomas H. Fritts in 1967 (although first reported by Cole, 1978). It is by far the distributionally smallest of all taxa and enclaves of the *S. variabilis* complex, being limited, so far as is now known, to coastal Tabasco, north of the inland range of *S. teapensis*. The specimens Cole (1978: 8) reported of this enclave were referred by him to *S. v. teapensis*, on distributional grounds; we are confident, however, that they represent *S. v. variabilis*, since they agree in dorsal scale count (49-51) with his counts for that subspecies, and not with his counts (36-47) for *S. teapensis*. Playa Paraiso, where Cole's specimens came from, is bracketed by the large series we have examined from Tabasco, all clearly *S. v. variabilis*. Ramírez and González (1991) reported reproductive data on this enclave, properly identified.

Although it seems highly unlikely, these three enclaves may actually have continuity, inasmuch as at least limited sympatry with *S. teapensis* is now known to occur.

The subspecific taxon *S. v. olloporus* that we here revive ranges from eastern Guatemala south of Petén to Costa Rica, intergrading with *S. v. variabilis* in southwestern Guatemala and adjacent Chiapas.

Observations on each of these seven taxa and enclaves follow.

1. *Sceloporus smithi*. This taxon is arguably the most highly differentiated and distinctive of the *S. variabilis* complex, at least compared with sympatric and adjacent members. It is immediately recognizable at all postembryonic stages in both sexes by its distinctive pattern, having a very dark, chocolate brown to black ground color on back and sides, without or with very dim dark spots, and brilliant white, wide (2 and 2 half-rows at widest point) dorsolateral stripes. No other taxon of this complex has such a pattern, and no other is distinguishable by pattern. The dorsal scale count is higher (54-69, \bar{X} 62-63, fide Hartweg and Oliver, 1937, and Sites and Dixon, 1982) than in any other taxon in the complex except *S. v. marmoratus* (54-72, fide Sites and Dixon, 1982:19). The small size of the body scales is reflected in both taxa by the large number of rump (11-14, \bar{X} 12, and 11-15, \bar{X} 12.5, respectively) and nape (13-17, \bar{X} 15, and 14-18, \bar{X} 16, respectively) rows, with means higher than in any other populational segments here treated of the complex. The rump rows in both taxa are 12 or more in at least 85% of the specimens examined, but in no more than 22% (range 0-22) of all other populational segments. The highland populations of Hidalgo and Querétaro, as noted by both Smith (1939) and Sites and Dixon (1982), referred to *S. v. variabilis*, also have small body scales, similar to those of *S. v. marmoratus* and *S. smithi*, but we have not dealt here with their taxonomic status, having seen but five specimens of them. They may well constitute a distinct race.

Other peculiarities of *S. smithi* include the extraordinary pink tail-tip of juveniles, previously mentioned; no other *Sceloporus* exhibits such urophely. The striking alignment of the keels of the dorsal scales, forming conspicuously continuous ridges, is also unique. The species holds the present record of maximum s-v length (78 mm, UCM 39859) in the complex, although both *S. v. variabilis* and *S. teapensis* may reach the same size, with a recorded maximum of 74 mm for the latter (Boulenger, 1897) and 76.4 mm for *S. v. variabilis* (UIMNH 10927, Tonalá, Chiapas, fide data kindly provided by Dr. Jack Sites; two other specimens in the same series, UIMNH 10938-9, measured 75.4 and 75.9 mm s-v). *S. v. olloporus* reaches much the same maximum, at 74.8 mm (KU 85916). Even the peculiar Querétaro population of *S. v. variabilis* approaches the maximum, at 73.9 mm (TCWC 29763).

Hartweg and Oliver (1937) noted that females of *S. smithi* are of much the same color as males "except that the colors are in general less intense", and that their abdominal semeions are "not so distinctly bordered, and they exhibit very little of the pinkish hue." Nevertheless, females of *S. smithi* regularly exhibit distinct abdominal semeions, whereas they are not evident at all in female *S. teapensis*, and seldom in *S. variabilis*.

A quite subjective difference between *S. smithi* and its adjacent taxa (*S. teapensis* and *S. v. variabilis*) is the reduced size of the central lateral abdominal scales, and the concomitant existence of a longitudinal ridge extending from near the lower margin of the axilla along the upper side of the abdomen to near the groin (but not into it). So far as we are aware, that ridge is unique to the species.

S. teapensis and *S. smithi* represent the extremes of body scale size in the entire complex and also of pattern. Therefore it is not surprising that they are extensively sympatric. Reproductive isolation is no doubt at least reinforced if not largely dependent upon visual interspecific discrimination, given the sharp distinction in coloration between the two species.

Sympatry of these two species in the same localities is documented by several UCM specimens, all collected by that legendary naturalist Thomas MacDougall, who, although primarily a horticulturist, collected many vertebrates for the American Museum of Natural History, the University of Illinois Museum of Natural History, the University of Colorado Museum and the University of Kansas Museum of Natural History. Three *S. teapensis* (39849-51) and one (39852) *S. smithi* were taken near Palomares, Oaxaca, a few kilometers northeast of an area well represented in various museums by the former species (Tollosa, Tollocito, Real de Sarabia, La Princesa, etc.). As indicated on the accompanying map, however, *S. smithi* has long been known in nearby localities, as in the Juchitán region. There is no reason to doubt its occurrence there. MacDougall also obtained three of the latter species (38957-9) and one *S. teapensis* (39848) at Tamasola, district of Tequisitlán, Oaxaca, a locality northwest of Tehuantepec and almost in the middle of the range of *S. smithi*. All sympatric specimens are completely typical of their taxa.

Although clearly no intergradation exists between *S. teapensis* and *S. smithi*, two specimens (KU 43733-4), here assigned to the latter species, appear to be hybrids with *S. teapensis*. Both are adult females and have the scutellation typical of *S. smithi* (dorsals 68-70, rump rows 14-14, nape rows 17-16, canthosubnasals 3-3, lateral folds present), but their dorsal pattern is typical of *S. teapensis*. They were taken 2 mi N, 6 mi W Nejapa, Oaxaca, well within the range of *S. smithi* (see Fig. 6). We can interpret these specimens only as hybrids; they are the only evidence of which we are aware that interbreeding ever occurs between *S. teapensis* and *S. smithi*.

It is not equally apparent the *S. smithi* does not intergrade with, and is therefore not a subspecies of, *S. v. variabilis*, of which a population (COG) is isolated in southern Chiapas and immediately adjoining areas to the west in Oaxaca and to the east in Guatemala. Typical *S. smithi* occurs as far

southeast as Ixtepec, Oaxaca (FMNH 1472(7)), and typical *S. v. variabilis* (COG) as far west as Niltepec, Oaxaca (FMNH 1468, 99251-2, UIMNH 21954), localities only 53 air km apart. It remains uncertain, however, how these two taxa interact between these two localities, if indeed their ranges actually meet, as seems likely.

Hartweg and Oliver (1937: 4) claimed that "There is a specimen from Tapanatepec, Oaxaca (UMMZ 78852), which appears to be an intergrade between the two subspecies; it retains the coloration of *smithi* but exhibits the scale formulae of *variabilis*." Smith (1939: 281), referring apparently to the same specimen, stated that it "tends strongly toward *v. variabilis*, having a dorsal scale count of 55. The dorsal coloration, however is identical with that of *v. smithi*." We have concluded, however, that some mixup of data has been responsible for this erroneous record of an intergrade. Smith did not list any specimen from Tapanatepec under "*S. v. smithi*", and the only ones from there under *S. v. variabilis* were two MCZ specimens (33454-5). We have re-examined those two, as well as four others from nearby (KU 37791, 2 mi E Tapanatepec; UTA 5674, Cerro Baul, 22 km N Tapanatepec; UIMNH 37356, 37264, Plan de Campaña, Río Porto Moneda, 30 km NNEN Tapanatepec, on Gulf slopes), and all are typical COG *S. v. variabilis* in both scutellation and coloration (although KU 37791 does have a distinct lateral fold). The so-called "intergrade" cannot be found. Greg Schneider kindly verified Jan. 30, 1992, that UMMZ 78852 was cataloged with eight specimens; seven are now present, all *S. siniferus* obtained in exchange with MCZ; the identity and whereabouts of the missing, eighth specimen is unknown. José Rosado kindly reported Febr. 5, 1992 (in letter) that indeed seven specimens are missing from the original series of 19 duplicates of *S. siniferus* entered under MCZ 28326-75. However, one specimen from the tagged series is missing, although its loose tag remains in the jar. It now appears impossible to verify the record of an intergrade from Tapanatepec, and we conclude that it should be disregarded until confirmed with either new material from that area or rediscovery of the specimen originally reported. On the other hand, it is quite likely that the specimen referred to is actually UMMZ 88404 from Arriaga, Chiapas, only some 32 km ESEE of Tapanatepec, since it is cataloged as *S. v. smithi*. Greg Schneider kindly recorded the following data on it: a poorly preserved juvenile, 25 mm s-v, with 52 dorsals, dorsal coloration very dark, dark spots scarcely visible, dorsolateral light lines well defined and as much as three scales wide. More material from that area would be required for definitive conclusions. The locality is so distant from verifiable records of *S. smithi* that we suspect discoloration is responsible for its resemblance to that species. We accordingly here regard it as representing *S. v. variabilis*, although it may possibly (although we think it unlikely) represent a hybrid between the two taxa.

In support of the intergradation concept, Smith (1939: 281) also stated that "Specimens of *v. variabilis* from El Hule, Oaxaca, tend somewhat toward *v. smithi* in coloration". However, El Hule is nowhere near the range of *S. smithi*; it lies on Atlantic slopes just south of the Veracruz border and just north of 18° N latitude (see Fig. 6), and the specimens from there cannot be influenced by the *S. smithi* genome.

There simply is insufficient material available at the present time to demonstrate conclusively whether intergradation occurs between *S. smithi* and *S. v. variabilis*. Apparently that material should be sought in the area between Ixtepec and Niltpec, Oaxaca. Certainly since *S. smithi* and *S. teapensis* can hybridize, interbreeding between the former and *S. v. variabilis* should be possible. Nevertheless the very distinctive coloration of *S. smithi* should be highly effective in interspecific discrimination by the lizards themselves, maintaining their separate identities. Furthermore, *S. teapensis* and *S. variabilis* appear to maintain their separate identities, in spite of a greater superficial similarity than exists between *S. smithi* and *S. variabilis*, where their ranges are closely approximated and even interdigitated in Guatemala and on Atlantic slopes of southern Veracruz and Tabasco (see following discussion).

We accordingly conclude that *S. smithi* is allospecific to both *S. teapensis* and *S. variabilis*; that relationship to the former is well assured, but to the latter requires confirmation.

2. *Sceloporus teapensis*. The taxonomic validity of *S. teapensis*, at least as a subspecies of *S. variabilis*, as never been refuted. Its primary claim to validity has always been its large scales on body, 36 to 49, whereas its adjacent relative, *S. v. variabilis*, usually has 50-61. Although most data in Sites and Dixon (1982) for *S. teapensis* conform approximately with those of Smith (1939) and Cole (1978), with an upper limit of 50 (the counts by Sites and Dixon extended to the level of the anus instead of the rear margin of the thighs, hence typically included 1-2 scales more than counts by the other workers), they cite a maximum of 58 in their series from the vicinity of La Libertad, El Petén, Guatemala. That series, however, included at least three *S. chrysostictus* (KU 55805, 55810, 55825) with 47, 50 and 53 dorsals (their counts). One other specimen (KU 59714), in the same series, they reported with 54 dorsals, a figure that cannot be verified because that specimen has now been skinned, cleared and stained; since other specimens of *S. chrysostictus* were accepted as *S. variabilis* and had comparably high counts, however (ranging in the species 42-57, fide Smith, 1939), and all other confirmed *S. teapensis* in their data, from that locality, had 42-50 dorsals, we conclude that KU 59714 also is a *S. chrysostictus*. One other specimen, UMMZ 74972, reported with 58 dorsals, actually has 43 or 44,

hence 58 is a clerical error. Thus 49 remains (by the thigh-level count) as the usual maximum for *S. teapensis*.

Nevertheless, considerable overlap of even this restricted range of dorsal scale counts of *S. teapensis* occurs with *S. v. variabilis*, according to the data in Sites and Dixon (1982), and also our own data. The lowest count for *S. v. variabilis* in Sites and Dixon (1982) is 43, occurring in a series from Playa Miramar (11 km SW Frontera), Tabasco. We have examined the same series, and the lowest count obtained in it was 45 (UIMNH 87391). Since the methodology of Sites and Dixon should yield higher, not lower counts, we assume that the count of 43 is a lapsus for some higher number. Even with a minimum dorsal count of 45 in *S. v. variabilis*, the overlap with *S. teapensis* is considerable, 45-49. More important, the nearest samples of *S. v. variabilis* to the range of *S. teapensis*, as given by Sites and Dixon, to the west in Veracruz (19 km N Alvarado and 8 km N Lerdo de Tejada), and to the east in Tabasco (Sánchez Magallanes and Playa Miramar) have means more closely approaching those of *S. teapensis* than any others of the subspecies west of Chiapas and Guatemala.

Our own data on number of rump and nape rows, as well as these rows totaled (see Table 1) reveal strong but incomplete distinction between *S. teapensis* and *S. v. variabilis*, the former usually having lower counts than the latter. The samples from Tabasco and Alvarado areas of *S. v. variabilis* more closely approach *S. teapensis* in these respects than do others of their subspecies, paralleling the trends in dorsal scale counts.

The reduced number of canthosubnasals (2-2) is also characteristic of *S. teapensis*, as compared with *S. v. variabilis* with 3-3, although to a somewhat lesser degree. However, again the frequency of occurrence of two is lowest in samples of *S. teapensis* from Oaxaca and Veracruz, which lie near the range of the northern populations of *S. v. variabilis*, as compared with the samples elsewhere, even though in Guatemala the two taxa occur in some areas in near parapatry or in sympatry.

Although *S. teapensis* usually has fewer rump and nape rows, and fewer canthosubnasals, comparisons of the sums of all three with the same figures for *S. v. variabilis* gives no better separation of the two taxa than the dorsal scale count (see Table 1).

An apparent documentation of sympatry of the two taxa exists in the form of one *S. variabilis* (UTA 20752) and seven *S. teapensis* (UTA 20333-5, 20748-51) cataloged from Finca La Perla, El Tesoro, El Quiché, Guatemala, Jan. 9, 1986, J. A. Campbell. Campbell has confirmed (pers. comm.), however, that the single *S. variabilis* was not collected by him there, although the others were; the *S. variabilis* was given to him by a friend who had

recently come from the southern highlands of Guatemala, where that species is well known; its exact origin is uncertain, but is definitely not the same as the seven *S. teapensis*. It presumably represents *S. v. olloporus*, having 20 femoral pores.

Although no documentation now exists of sympatry of the two taxa in Guatemala, they are recorded in close proximity in several areas in various works by L. C. Stuart, who never reported either any difficulty in distinguishing them, or populations that appeared intermediate. Most impressive is his 1943 report of 10 *S. teapensis* from Finca San Francisco ("forty-one miles east and slightly north of Huehuetenango"), virtually surrounded by records for *S. variabilis*. We likewise have found no intermediates in Guatemala or Chiapas, and none is evident in those areas in Sites and Dixon's (1982) revision.

Most recently, Campbell and Vannini (1989) summarized the ranges of the two species in Guatemala by faunal areas; their conclusions support ours. They note occurrence of only *S. teapensis* in the Petén area, and only *S. variabilis* in the Zacapan, Jalapan and Fuegan areas; both are recognized in the Quecchian area and the Cuchumatán subarea of the Huehuetenangan area. Range overlap and interdigitation are likely in both of the latter two regions.

It is thus our conclusion that to the south, where *S. teapensis* extends into Oaxaca on the west, and in Chiapas and Guatemala elsewhere, it is sympatric or parapatric with *S. smithi* (Oaxaca) and *S. variabilis* (both southern subspecies) with no evidence of intergradation. Whether the species occurs in extreme northwestern Honduras is unknown, but it is unlikely since Jonathan Campbell has not found it in the Puerto Barrios area (pers. comm.). Indeed, no representatives of the *S. variabilis* complex has been found between Lago de Izabal/Río Dulce and the Honduras border. If present, they presumably would represent *S. v. olloporus*.

On the contrary, the contact zones with the Northern Gulf and Southern Gulf enclaves of *S. v. variabilis* give clear indication of the mutual influence of one taxon on the other. Introgression has apparently occurred in both directions, but whether it continues at present is uncertain. The rather narrow zones of intermediacy suggest that the contacts are secondary and that interbreeding is infrequent. However much the means approach each other toward the lines of parapatry, no sample yet reported is really ambiguous of allocation. The nearest geographic approach yet sampled of *S. v. variabilis* to *S. teapensis* is Sites and Dixon's (1982) series from 9 km NE of Lerdo de Tejada, Veracruz, and on the basis of dorsal scale count most of that series ($\pm 75\%$) falls with *S. v. variabilis*. We have not seen that series, but

another (JFBM 2852, 2858, 2860-1, 2865) from very close nearby (2 mi S Tlacotalpan, 1; 1.8 mi S Buena Vista, 4) is definitely referable to *S. v. variabilis* (all with 3-3 canthosubnasals, rump rows 10-11, nape rows 13-14).

No coastal or near-coastal samples are known to us from the presumed actual contact zones of *S. teapensis* and *S. v. variabilis*; a hiatus of some 60 km or more, whence specimens of neither taxon are known, exists to both the east and the west. Whether intergradation or hybridization occurs in those zones is uncertain; variational overlap elsewhere suggests that but one intermediate population occurs, but sympatry of two separate populations is not ruled out.

The most critical series of specimens we have examined in this context is the one from Veracruz designated VVNGS in Table 1. Those 39 include the ones already mentioned from Buena Vista and Tlacotalpan, and 35 as follows: coast road 20 mi SE Veracruz [= 48 km NW Salinas], UCM 45615; 15 mi NW Alvarado [= 2 km SE Salinas], UCM 50767; beach 5 mi SE Salinas [= 17 km NW Alvarado], UCM 39460-72; 4 km SE Alvarado, KU 59706-10; and Alvarado, KU 26736-7, 26740, 26742-3, 26752, 26754, 26756, 26761, 26764-6, 27037, 44383. All of these 35 represent *S. v. variabilis*, but there is a strong tendency toward the characters that define *S. teapensis*, viz. rump rows 8 in one, 9 in six, 10 in twenty-one, and 11 in seven; nape rows 11 in four, 12 in two, 13 in fourteen, 14 in ten, 15 in three, 16 in one. The canthosubnasals are 2-2 in two, 2-3 in one, 3-3 in thirty-six. As indicated in Table 1, the number of rump rows in the 8-9 range, characteristic of *S. teapensis*, is distinctly more frequent of occurrence in the southern part of the Northern Gulf enclave of *S. v. variabilis* (nearest the range of *S. teapensis*) than elsewhere in that species (18% vs. 0-7%). The same is true of the nape rows; 11 or fewer (common in *S. teapensis*) occur in 11% of the VVNGS group, as opposed to 0-3% in other groups of the species. The canthosubnasals are, however, more or less typical of *S. v. variabilis*. No reciprocal tendency to have more numerous rump or nape rows is evident in the group of *S. teapensis* (Table 1, TOV) nearest the range of the Northern Gulf enclave, but the proportion with three (as in most *S. v. variabilis*) instead of two (as in *S. teapensis*) canthosubnasals is distinctly higher (39%) than elsewhere in the species (14%).

Thus the variation in the three most useful characters (rump and nape rows, certainly reflecting the size of the dorsal scales and the dorsal scale count, and the canthosubnasals) distinguishing these two taxa in southern Veracruz suggests rather strongly that they are not sympatric, as they may well be in Guatemala, but that they hybridize or intergrade there, or did so until relatively recently.

However, what really happens where the two taxa meet in southern Veracruz is unknown because there is a gap of 50-60 km or more between the most closely approximated known samples of the two species. The same sized hiatus occurs between known localities of record for *S. teapensis* and the Southern Gulf enclave of *S. v. variabilis*. *Variation elsewhere is no guarantee of intergradation or hybridization in the zone of contacts*, particularly since character displacement (divergence; Mayr, 1963: 82-85) may very easily occur where populations of the two species actually contact. That possibility is suggested by the variation in the series of *S. v. variabilis* from near Tlacotalpan and Buena Vista discussed previously; that series is from as near the range of *S. teapensis* as any, but shows no influence of *S. teapensis*. Character displacement is also evident in the number of rump rows less than 10 and number of nape rows less than 12 in populations of *S. teapensis* in Veracruz and Oaxaca (nearest the range of the Northern Gulf enclave of *S. v. variabilis*) compared with the other populations of that species (91% vs. 80%, and 81% vs. 71%, respectively; see Table 1). On the contrary, introgression is evident in number of canthosubnasals, two occurring in 61% and 86% respectively in the two groups of *S. teapensis* populations. In Guatemala, conversely, these examples of displacement and introgression between *S. teapensis* and *S. v. olloporus* are just reversed. Evidence of potential sympatry there, however, suggests that these phenomena ceased there before they did in the Veracruz area, if indeed they no longer occur in the latter region.

In addition, we have found two other subjective criteria that sharply distinguish the two taxa in the zone of presumed contact in southern Veracruz: the size of the lateral scales in the groin region and on sides of neck. Even the most *teapensis*-like *S. v. variabilis* seen, from 5 mi S Salinas, Veracruz (UCM 39472, with 8 rump and 11 nape rows), has the typical small groin scales and lateral nape scales of *S. v. variabilis* (Fig. 4). These distinctions between the two taxa appear to be constant although their subjectivity makes direct comparisons frequently necessary between individuals of known identity.

The relative size of the groin scales has been a particularly useful character in detecting sympatry of the two species in two hitherto unsuspected areas of co-existence in southern parts of the range of *S. v. variabilis* in Veracruz. Of two specimens from 1 km S Mocambo (just south of Cd. Veracruz), one (MZFC 218) is clearly *S. teapensis* (50 mm s-v female, 47 dorsals, 9 rump rows, 11 nape rows, large groin scales, but canthosubnasals 3-3), the other (MZFC 220) clearly *S. v. variabilis* (47 mm s-v, male, 49 dorsals, 11 rump rows, 13 nape rows, small groin scales, canthosubnasals 3-3). Yet a good series (UIMNH 40221-35) from 5.3 mi N Antón Lizardo, only some 20 km SE of Mocambo, are all *S. v. variabilis*, with small groin scales

and canthosubnasals all 3-3, although the dorsals vary 48-58, rump rows 9-11, and nape rows 12-14.

Several series in FMNH from southwestern Veracruz, from the vicinity of different railroad stations, are especially illuminating. The entire series (1476(11)) from Achotal, near the foothills, 33 km SW Acayucán, represents *S. teapensis* and is fully conformant with its characteristics. In a series of 32 from Pérez (1317, 1319, 1684), also near the foothills, 72 air km NW of Achotal, six represent *S. teapensis* (dorsals 46-48, rump rows 9(4) or 10(2), groin scales large, although two canthosubnasals occur on only two of 12 sides), all others *S. v. variabilis* (dorsals 48-55, rump rows 10-12, groin scales small, two canthosubnasals occur on only two of 12 sides), all others *S. v. variabilis* (dorsals 48-55, rump rows 10-12, groin scales small, two canthosubnasals on five of 49 sides). Out farther on the coastal plain, at San Francisco (13 air km NNW Achotal) (1331(10)) and at Ojapa (cataloged as Otopa; 1331(9), 1312(3); 31 air km NE Achotal) all specimens are *S. v. variabilis*. These series amply demonstrate sympatry of these two species in this area, and together with others, reveal that *S. v. variabilis* extends in the coastal plain far to the southeast between the isolated uplands of Los Tuxtlas and the Sierras of Oaxaca. Near the Isthmus of Tehuantepec, however, *S. teapensis* apparently occupies the coastal plain to the exclusion of *S. v. variabilis* (Figs. 6, 7).

Despite the apparent variability of interaction of the two taxa at various places where they meet in southern Veracruz, we conclude, based on irrefutable evidence of sympatry in some areas and *the infallibility of especially the character of relative size of the groin scales*, that, for the present, *S. teapensis* is properly regarded as a full species. That conclusion requires verification, either with collections in the critical zones of contact or by field observations. As superficially similar as the two species are, visual interspecific discrimination, as a deterrent to interbreeding, seems unlikely, unless behavior is a factor. Pheromones may play a role, or interspecific isolation may depend on postmating mechanisms. Only observations in the field or in field simulations are likely to provide definitive answers.

3. *Sceloporus v. variabilis*, Northern Gulf Enclave. This enclave is more heterogeneous than any of the others. Variational tendencies at its southern range extremity toward character-states of *S. teapensis* have been noted in the preceding discussion. Toward the north, in southern central Tamaulipas, a transition occurs into the small scales and small size of *S. v. marmoratus*. Thus the Northern Gulf enclave is intermediate between *S. v. marmoratus* and *S. teapensis* in size of scales on the body, and *S. v. marmoratus* is the smallest in body size not only of these three but of the whole *S. variabilis* complex.

Although in general the number of rump and nape rows is correlated closely with the size of the dorsal scales and their number from interparietal to base of tail, the correlation is not infallible. Four of seven specimens (KU 61732-8) from 10 mi NW Temapache, Veracruz, have only nine rump rows (the others have 10), but the nape rows are 13 in all four (two of the others have 14, one 13). Both high and low counts occur in the state of Hidalgo: two have nine rump rows, two have 12 nape rows, and one has 17 nape rows. Nine rump rows but 13 nape rows occur in three out of 24 from the Sierra de Juárez, Oaxaca. One of two from 15 km ESE of San Juan del la Punta, Veracruz, has 9 rump and 13 nape rows, and one specimen in 13 from 3 km SW San Marcos, Veracruz, has a rump-nape formula of 9-11. No others with as few as 9 rump rows in the Northern Gulf enclave have been seen from north of the area adjacent to the range of *S. teapensis*. In that same area scattered individuals have as many as 16 or 17 and as few as 11 nape rows, and up to 13 rump rows. Thus the number of rump and nape rows, as well as dorsals and canthosubnasals, seems to vary independently to a certain degree throughout most of the range of the Northern Gulf enclave.

The *S. v. variabilis* of Smith (1939) consisted solely of the Northern Gulf enclave, because the Southern Gulf enclave was not then known, and the COG enclave was referred to *S. v. olloporus*. The most nearly infallible objective distinction between the Northern Gulf enclave of *S. v. variabilis* and *S. teapensis* remains the dorsal scale count. Smith's data give a 100% separation, all *S. teapensis* having 47 or fewer (in 103), all *S. v. variabilis* having 49 or more (in 197). Cole (1978) found no *S. teapensis* with more than 47, but found the range in *S. variabilis* to be 46-69. No localities were given for the latter, but they may have included areas within the range of *S. v. olloporus*, in which 1% of 181 have 47 or fewer dorsals, with a range of 46 to 59 (Smith, 1937); 3% have 48 or fewer, 10% 49 or fewer. Sites and Dixon (1982) made dorsal counts to the anus rather than to the level of the rear margin of the thighs held at right angles to the body, resulting in figures exceeding Smith's (1937) and Cole's (1978) by one or two scales; nevertheless no samples from the Northern Gulf enclave have counts lower than 49 except five from the southern areas near the range of *S. teapensis*, and on the basis of that intermediacy intergradation could be assumed. In the discussion of *S. teapensis* we have proposed that it actually does not occur.

Only immediately to the north of the range of *S. teapensis* does the dorsal scale count criterion fail, and there the preinguinals and lateral nuchals provide an apparently infallible criterion.

Even in the area of proximity of the ranges of *S. v. variabilis* and *S. teapensis*, those two species are distinguished with at least 80% degree of accuracy by the number of rump and nape rows (see Table 1).

4. *Sceloporus v. variabilis*, Southern Gulf enclave. As indicated in Table 1, range of variation in the Southern Gulf enclave of both rump and nape rows is considerably less than that in the Northern Gulf enclave. However, only 70 specimens have been examined, from two localities, both in Tabasco. This enclave is known only from the coast of Tabasco, although since it occurs only 5 mi SW Frontera, Tabasco (UCM 39415-53), a locality only 31 km SW of the Campeche border, occurrence as far as the Laguna de Términos, Campeche, is likely. On the west, the enclave is recorded from Sánchez Magallanes, only 27 km from the Veracruz border, and accordingly it probably occurs in the latter state. Somewhere, between Sánchez Magallanes and the Coatzacoalcos-Minatitlán region, its range presumably meets that of *S. teapensis*, but no records are available from that approximately 61 air km interval. The enclave apparently does not extend northward beyond, at most, extreme southwestern Campeche, and to the south and east it is replaced by *S. teapensis*, in Veracruz, Tabasco, El Petén of Guatemala, and Belize.

This enclave, like others of its subspecies, is distinguishable from *S. teapensis* by its small preinguinals and lateral nuchals, and, more objectively, although presumably less infallibly, by its more numerous rump rows, nape rows and combined rump-nape rows; in the latter there is only a 4% and 5% overlap respectively (see Table 1). Dorsal scale counts, however, overlap extensively, as noted in the preceding discussion, although only a small percentage of the enclave falls below 48 (10%). The distribution of 31 counts is nevertheless skewed to the lower figures, 23% falling below 49, and 35% below 50.

Despite these peculiarities, the enclave is clearly referable to *S. v. variabilis*, not to *S. teapensis*, as correctly concluded by Ramírez and González (1991). The first specimens (four) reported of the enclave were referred at that time (Cole, 1978: 8) to *S. teapensis* primarily because they did then appear to come from "well within the range of" that species, and had 49-51 (\bar{x} 49.2) dorsals. To a considerable extent on these grounds *S. teapensis* was placed as a subspecies of *S. variabilis* by Cole, not being aware of the existence of a population of *S. v. variabilis* isolated north of the range of *S. teapensis*.

5. *Sceloporus v. variabilis*, COG enclave. Occurring in southeastern Oaxaca, central and southern Chiapas and adjacent Guatemala, this enclave is encircled by *S. teapensis* and *S. smithi*, and is separated by them from contacts with the other enclaves of its subspecies. Intergrades with *S. v. olloporus* occur in southeastern Chiapas and adjacent Guatemala (see discussion of *S. v. olloporus*). Its geographic range (Fig. 5) loosely interdigitates with that of *S. teapensis* in the vicinity of Berriozabal and Ocozocoautla, southwest of Tuxtla Gutiérrez, Chiapas, without evidence of

intermixing (e. g. Johnson et al., 1977). Similar range approximation and possible overlap occurs near Pichucalco, in extreme northern Chiapas, with COG known 15 mi S, and typical *S. teapensis* 4 mi NE, of Pichucalco.

Interaction of COG and *S. smithi* is uncertain, since specimens from critical areas of extreme southeastern Oaxaca are lacking (see discussion of *S. smithi*).

As indicated in Table 1, all three enclaves of *S. v. variabilis* are similar in all respects; the data in Sites ad Dixon on femoral pores and dorsals also agree.

6. *Sceloporus v. olloporus*. Sites and Dixon (1982) concluded that this subspecies is not valid, but their data, properly revised, combined with our own, support its recognition. Their data (hereinafter designated SD) show that a total femoral pore count of 21 or fewer characterizes 93% of the 27 counts available for Costa Rica, 91% of the 113 for Nicaragua, 85% of the 59 from Honduras, and 100% of the nine from 5-24 km NE Cd. Río Hondo, Zacapa, Guatemala. Our data are equally supportive: 100% of 58 from Belejú, El Quiché, Guatemala (in UCM 35023-84, 44571-44606); 83% of 6 from Zacapa Dept., Guatemala (in KU 59744-6). Two discrepant sets of SD data that we here correct are (1) a tally error assigning a count of 29 to Nicaragua (which actually pertains to UMMZ 101212, *S. v. variabilis* from 2 km N Miramar, Veracruz (south of Tampico, Tamaulipas), for which 24 was otherwise the highest); and (2) a figure of only 60% 21 or fewer for 10 specimens from El Salvador. We did not examine the SD specimens from El Salvador, but 92% of our counts (12) from El Salvador material (in KU 184254-69) are less than 22 (one exception, of 22); it is very difficult to make accurate counts of femoral pores on most females and juveniles, and we reject the SD counts as inaccurate in this particular series, in view of our different results obtained with great care.

These figures are consistent over a wide area from Costa Rica into Guatemala, and are in sharp contrast with the SD data for *S. v. variabilis* from Mexico. Excluding their samples of *S. teapensis* and *S. smithi*, the following percentages obtain of total femoral pore counts less than 22, arranged more or less in N-S order. The Gómez Farías region, Tamaulipas (SD locality 5), 4% of 25; 2 km N Miramar, Veracruz (south of Tampico), 3% of 31; Valles region, San Luis Potosí (SD locality 7), 0% of 20; Querétaro (SD locality 8), 0% of 235 (total range is 22-34, not 14-34 as in SD; the single 14 count is a lapsus for 14 + 17 (total 31) fide recheck by Dixon); Tecolutla region, Veracruz (SD locality 9), 0% of 16; Xalapa, Veracruz, 0% of 9; Cd. Veracruz, 3% of 41; 19 km N Alvarado, Veracruz, 10% of 10; 8 km N Lerdo de Tejada, 0% of 14; Cosolapa, Oaxaca, 0% of 26; Soyaltepec, Tuxtepec dist., Oaxaca, 9% of 11; Sánchez Magallanes, Tabasco, 8% of 12; Playa Miramar,

11 km SW Frontera, Tabasco, 4% of 24; Chiapa de Corzo, Chiapas, 11% of 9; Tonalá, Chiapas, 8% of 12; and Jacaltenango, Guatemala, 8% of 25. The data for the Playa Miramar series are our own, based on UCM 39415-53, of which only 24 could be counted reliably; the 15 SD counts, based on UIMNH material taken with the UCM series, and of which 53% are lower than 22, we are convinced are inaccurate, since most specimens involved are females or juveniles, which are usually very difficult or impossible to count accurately.

Thus throughout the extensive ranges of both *S. v. variabilis* and *S. v. olloporus*, except for a small intervening area in southwestern Guatemala and adjacent Chiapas, the two subspecies are consistently different, without evident clinal convergence. The level of conformance with the stated criterion is at least 89% in any given area represented by the 520 tallied *S. v. variabilis* (an over-all conformance of 98%, 12 exceptions), and is at least 83% in any given area represented by the 275 tallied *S. v. olloporus* (an over-all conformance of 92%, 22 exceptions).

Excluded from the tallies for *S. v. olloporus* is a series of 21 specimens (in UTA 8948-9, 20329-32; KU 59717-30, 157471-2, 187174-8, 187180-2) from El Progreso Dept., Guatemala, which have only 67% with less than 22 femoral pores; part of that series was included in the SD data (locality 32), with a comparably low percentage (73%). The lowest percentage elsewhere is 83% for Zacapa Dept., Guatemala. Only in this area of Guatemala is there clear evidence of an approach of *S. v. olloporus* to the characteristic numerous femoral pores of *S. v. variabilis*. Yet typical populations of the latter subspecies are nearly 150 km to the west, with typical populations of *S. v. olloporus* intervening. It seems likely that their ranges were more nearly approximated in the past, and that the El Progreso populations reflect that approximation to some extent.

Unfortunately sufficiently large series from sufficiently numerous localities in central and western Guatemala are not available as yet to provide a satisfactory picture of distribution of the subspecies there, and their areas of intergradation.

However, at least four series referable to *S. v. variabilis* show the influence of *S. v. olloporus*, all from the Chiapas-Guatemala border south of 16° north latitude, and all (SD data) with 33-40% of the femoral pore counts less than 22. In Chiapas, 40 from Comitán have 40% (16) with fewer than 22 femoral pores, and 14 from Zapaluta have 37% (7); in Huehuetenango, Guatemala, 9 from Río Cuilco have 33% (3), 12 from 2 km SW Colotenango also have 33% (4), and three from 33 km WNW Huehuetenango, El Tapón area (our data) have 33% (1).

Stuart (1954) long ago deciphered the distribution of these two subspecies in Guatemala, mapped their locality records, noted apparent intergradation exactly where indicated here (at Canibal, on Rio Cuilco), and declared that neither is particularly closely related to either *S. cozumelae* (lapsus for *S. chrysostictus*) or *S. teapensis*, both of which occur nearby on the Caribbean versant.

The most conspicuous geographic variation observed in *S. v. olloporus* is in number of postrostrals, 70% (in 62) of which are less than 4 in Costa Rica material, 68% (in 196) in Nicaragua specimens. In Honduras material (22 specimens), 32% have fewer than 4, much as in *S. v. marmoratus* (33% in 44), and in El Salvador 23% (3 of 16) have fewer than 4. All other samples of *S. v. olloporus*, *S. v. variabilis*, *S. smithi* and *S. teapensis* have no more than 19%, and as little as 6%, with fewer than 4 postrostrals. Unless other distinctions are found in the Costa Rica-Nicaragua populations, no taxonomic separation of them from *S. v. olloporus* seems justified, although their postrostral deviation from other populations suggests that genetic exchanges with more northwestern populations may be reduced.

7. *Sceloporus v. marmoratus*. This diminutive subspecies, the northernmost of the complex, extending into Coahuila on the northwest (González et al., 1989), poses no major problem taxonomically. Its small size and numerous dorsals are its most distinctive characteristics. Counting the dorsals even to rear margins of the thighs, Smith (1939) found 91% of *S. v. marmoratus* with 60 or more, 93% of *S. v. variabilis* with 59 or fewer. However, the data taken by Sites (for Sites and Dixon, 1982), with dorsal counts taken to the level of the anus, do not provide such a sharp separation. Their locality areas 1-4, in Texas and central Tamaulipas, yield the best separation with 79% (of 173) having 61 or more, as compared with only 26% (of 90) in their areas 5, 6, and 7 in southern Tamaulipas, southern San Luis Potosí and extreme northern Veracruz. The separation is better for their locality areas 9 and 10 in central Veracruz (17% 61 or more in 24 specimens). Their locality area 8, in Querétaro, is not considered here because an upland race, probably extending into Hidalgo (Mendoza, 1990) may be involved that has not yet been studied carefully.

Maximum size conforms with the geographic parameters dictated by the dorsal scale counts. In 174 specimens measured by Sites (in Sites and Dixon, 1982) from their locality areas 1-4, only one reached 57 mm s-v (measuring only 57.4 mm), and only 28 (16%) measured as much as 50 mm. Their 91 measurements for locality areas 5-7, on the contrary, reached a maximum of 71.9 mm, and 66 (73%) measured 50 mm or more. That large size is maintained throughout the range of *S. v. variabilis* and *S. v. olloporus*, except perhaps in the Tabasco series, which averages smaller than other

samples in s-v length. The maximum in that series of 70 is 67 mm, and only 43% measured 50 mm or more - figures still distinctly greater than those of *S. v. marmoratus*.

The small size of the dorsal scales is reflected not only by the standard dorsal scale count but also by the numerous nape and rump rows (84% 15 or more, 87% 12 or more, respectively). Only *S. smithi* of the *S. variabilis* complex is similar, with 50% and 85% respectively. All other populations (see Table 1) have 18 or 19% or less, respectively, except for the Northern Gulf enclave of *S. v. variabilis*, with over-all percentages of 29 and 19, respectively and slightly higher percentages to the north (32 and 22, respectively). *S. v. marmoratus* and *S. smithi* likewise have the highest summed nape and rump counts, and of those totaled with the canthosubnasal count (see Table 1).

Despite the small size of its dorsal scales, *S. v. marmoratus* lacks the lateral ridge fold characteristic of *S. smithi*, the only other taxon now recognized with small dorsals.

Curiously, *S. v. marmoratus* has the highest frequency (23%) of three or fewer postrostrals outside of southern (Nicaragua, Costa Rica) *S. v. olloporus* (68%); northern *S. v. olloporus* is about the same (22%) (see Table 1). Equally strange is the relatively high frequency of only two canthosubnasals (31%) in *S. v. marmoratus*, a feature usually characteristic of *S. teapensis* and occurring elsewhere to no more than 10% of the specimens examined, except for the COG enclave of *S. v. variabilis*, with 21% (see Table 1).

The range of *S. v. marmoratus* in Texas is thoroughly detailed in Axtell (1988); comparable detail in Mexico awaits the future, but it is clear that the area of intergradation with *S. v. variabilis* lies very close to or blankets the Tropic of Cancer in at least part of its extent. It lies close to El Mante, Tamaulipas; three specimens (KU 61743-5) from 29 mi E El Mante, Río Guayalejo, are clearly representative of *S. v. marmoratus* (13 rump rows, 16-17 nape rows, 56 mm s-v- maximum), whereas 5 mi W El Mante (KU 61740-1) the sample clearly represents *S. v. variabilis* (11 rump rows, 15 nape rows, 69 mm s-v max.), as does another specimen 12 mi S El Mante (KU 61739, with 10 rump and 13 nape rows). Apparently *S. v. marmoratus* extends farther south near the coast, and *S. v. variabilis* farther north near the Sierra Madre Oriental.

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Key to Members of the *Sceloporus variabilis* Complex

In the following key, the dorsal scale count is interpreted as the least count between interparietal and the level of the rear margin of the thighs held at right angles to the base of tail. The rump row count is the least dorsal scale count across the sacral region anterior to the level of midthigh but posterior to the level of anterior margin of the thighs held at right angles to the body axis. The nape row count is the least dorsal scale count across neck between the levels of arm insertion and ear openings.

- 1 A. Dorsal scales 49 or fewer (about 98%); rump rows 7-9 (85%; no other taxa more than 3%, although variation in 5 regions of *variabilis* is 0-18%); rump, nape and canthosubnasal total count 20-27 (97%; no other taxa more than 6.2%, although variation in 5 regions of *variabilis* is 3-13%); scales just anterior to groin relatively large, more than half size of median lateral abdominals; median lateral nape scales about same size as enlarged scales on crest of lateral nuchal fold *teapensis*

- B. Dorsal scales 50 or more (about 98%); rump rows usually 10 or more (all taxa no less than 97%, although variation in 5 regions of *variabilis* is 82-100%); rump, nape and canthosubnasal total count 28 or more (all taxa no less than 93%, although variation in 5 regions of *variabilis* is 87-97%); scales just anterior to groin relatively small, much less than half size of median abdominal laterals; median lateral nape scales distinctly smaller than enlarged scales on crest of lateral nuchal fold 2
- 2 A. Ground color uniformly very dark, with no or faint dark spots evident on sides or between prominent dorsolateral white stripes; latter usually 2 and 2 half scale rows wide at widest part; adult females with abdominal semeions well developed; hatchlings pink-tailed; rump rows 12 or more (85%); keels on dorsal body scales forming conspicuous, continuous fine ridges; median lateral abdominal scales little larger than border axillary and groin scales, lying on a longitudinal ridge; to 78 mm s-v *smithi*
- B. Ground color gray to brown, with dark spots readily evident on sides of body and in two paravertebral series median to dorsolateral light stripes; latter not so prominent or wide; abdominal semeions not or but dimly evident in adult females; hatchling tail of same ground color as body; rump rows variable; keels on dorsal body scales not forming conspicuous, continuous ridges; median lateral abdominal scales much larger than border axillary and groin scales, not on a longitudinal ridge; maximum s-v length 76.4 mm 3
- 3 A. Dorsal scales 60 or more (91%); rump rows 12 or more (87%); maximum s-v length 57.4 mm *v. marmoratus*
- B. Dorsal scales 59 or fewer (93%); rump rows 11 or fewer (83% for all enclaves, which vary 78-100%); maximum s-v length 76.4 mm 4
- 4 A. Femoral pores total 21 or fewer *v. olloporus*
- B. Femoral pores total 22 or more *v. variabilis*

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Appendix

Specimens we have examined, or that have been examined for us, in the course of this study are as follows.

Sceloporus smithi. OAXACA. AMNH: "Labo Sepas", nr Tehuantepec (66897). KU: 2 mi ESE Tehuantepec (42049); 3 mi NW Tehuantepec (37806);

6 mi WNW Tehuantepec (42045-8). UCM: *Juchitán Dist.*: Cerro de Potosí, nr Chahuities (44425-33); Palomares (39852); *Tehuantepec Dist.*: Cerro San Pedro (39856); El Limón (39855, 41131-5); Escurano (39853-4); Tamasola, nr Magdalena Tequisitlán (39857-9); *Tlacolula Dist.*: 2 mi S Totolapan, 3700' (16698); *Yautepec Dist.*: San Juan Acaltepec (44424). UIMNH: *Yautepec Dist.*: 1.9 mi SE La Reforma (40177). UMMZ: *Yautepec Dist.*: 5.4 mi NW El Camarón, 2100' (114942); 7.9 mi SE El Camarón, 4100' (126227).

Sceloporus smithi x *S. teapensis* hybrids (referred to *S. smithi*). OAXACA. KU: *Yautepec Dist.*: 2 mi N, 6 mi W Nejapa (43733-4).

Sceloporus teapensis. BELIZE. KU: *Cayo*: 1.1 mi S Georgeville (157451); 31.5 mi S Georgeville (157448-9); Río (157450); Xunantunich (144946, 171505-7); *Stann Creek*: 13.2 mi SW Silk Grass (157452). CHIAPAS. KU: Palenque ruins (94096-9); 3.5 km NW Pichucalco (94102); 4 mi NE Pichucalco (94100-1). UCM: Palenque (49668-72, 49674). GUATEMALA. KU: *Alta Verapaz*: Finca Chicoyou, nr Cobán, 980 m (59715-6); *El Petén*: 2.5 mi W El Cruce (157460-1); 34.6 mi E El Cruce (157468-9); 48.2 km W Melchor de Mencos (171482); 4 mi N Poptún (157453-5); 9.9 mi NW Poptún (157456); 12.1 mi NW Poptún (157457-9); 2.5 km N Ramate (171488-504); 8.3 mi SW San Benito (171483-7); 3 mi S Tikal (157463-7); 14.2 mi S Tikal (157462); 15 km SE La Libertad, Toocog (55808-9, 55811, 55816-24, 55826-34, 59712); *Izabal*: Las Dantas, W El Estor, 30 m (187173). UCM: *El Petén*: Sayaxche (22275). UTA: *Alta Verapaz*: 5.1 mi NE Cobán (33618-20); *El Quiché*: Finca La Perla, El Tesoro (20333-5, 20748-51); *Izabal*: El Estor, El Chupón (29258); El Estor, El Zapotillo (29279); Sierra de Santa Cruz (E side Cerro 1019, by Aldea La Libertad, 29280, 24294-6; Cerro Caná Tomasa, S side, 29259-66, 29278, 33624-7; S side Cerro La Dicha, 29285; Chichipate, 23575-6, 29281-4; Chinamococh, 29267-9; Finca Semuc, 3 rd km S hdqtrs, 29838; Finca Semuc, 4.5 rd km S hdqtrs, 22110-1; Marcajam, 29270-7; Seshán, 23577-85, 29286-93); *El Petén*: San José (33621-3); San Francisco (23586); Tikal (22109). OAXACA. AMNH: Ocotál, betw Matías Romero and Santa María Chimalapa (65029-30). FMNH: Santiago Guevea (113898-113903). KU: 20 km S Jesús Carranza, Veracruz (24260, 24382, 24384); Tolloquito (39684-5); 2 mi E Tolloquito (44857); 2 mi S Tolloquito (44858, 44860-3, 44873-4); 2 mi S Tolloso (33796). MZFC: Jalahui, 290 m (5421); 1.47 km W Jalahui (5422-4). UCM: 12 de Julio, Donají (44423); Palomares (39849-51); Real de Sarabia, 7 mi S (18984); Tamasola, Tequisitlán (39848). UIMNH: Coatlán (37343). VERACRUZ. FMNH: Ochotal (1476 (11)); Pérez (1317(3), 1319(3)). JFBM: nr Cerro Balzapote (10178, -87, 10201, -3, -14, -62-8, -70, -89, 10469-70). KU: 5 mi S Catemaco (39686, 44859); 20 km ENE Jesús Carranza (27519-23); 3 km E San Andrés Tuxtla (24162, 24249, -67, -9, -71, -5, 24379). MZFC: 6 km NE Coyame (FMQ 2178-9); E slope Volcán

San Martin (FMQ 2156-4); 1 km S Mocambo (218). UCM: Coyame, Lake Catemaco (28773-7, 28779-81, 28783-28809, 28811-45); 4 km N Coyame (28846-64).

Sceloporus v. marmoratus. NUEVO LEON. KU: 4 mi W Allende, Río Ramos (68106, 68108); Paraje de los Osos, Santiago (92608-11). TAMAULIPAS. KU: 8 mi S Llera (61747); 20 mi E Mante, Río Guayalejo (61743-5). TEXAS. KU: Atascosa Co. (Benton, 7227); Bexar Co. (Helotes, 11005-8); El Paso Co. (El Paso, 15572; locality erroneous, Axtell, 1988: 6); Frio Co. (Dilley, 12468; 11 mi W Dilley, 15192-8); Lasalle Co. (15 mi N Encinal, 15205-6); Nueces Co. (15 mi SE Corpus Christi, 88344-9); San Patricio Co. (7 mi NE Sinton, 61729-31); Starr Co. (Río Grande City, 15354-5; Los Olmos Bridge, Río Grande City, 15199-203; 3 mi NE Río Grande City, Hy 755, 145800; 6 mi W Río Grande City, Arroyo El Salado, 12467); Webb Co. (17.3 mi S jct Hy 59 & 2050, 145801-3).

Sceloporus variabilis olloporus. COSTARICA. KU: Guanacaste: 10 km W Bagaces (102442-4); Cornelco (157792); El Coco (67296; 2 km SW, Ojotal, 67290-5; Playa de, 100709-41, 125552-60); Guardia (3 km N, Río Tempisque, 125551; 10 km N, 102445); La Cruz (27 km S, 212 m, 95519; 44 km S, 133 m, 95520); betw Los Angeles and Tilarán (36861); 23 km S Peña Blanca, 227 m (95518); Sardinal (125561); Puntarenas (34846); Maribella Hotel (34226-44). EL SALVADOR. KU: Cuscatlán: Tenancingo (Río Tizapa, 184255, 184257-61; 2.8 km NE, Río Quezalapa, 184264-6); San Miguel: San Antonio Chávez, 10 km NNE San Miguel (184254, 184256-7); S Side Volcán San Miguel (184262-3); Santa Ana: Metapán (6 km S, 184268; 7 km SE, 184269). GUATEMALA. KU: Baja Verapaz: 18 km N Salamá, 1500 m (59744-6); Zacapa: Gualán, Aldea Doña María, 200-450 m (190787-9); Río Hondo (5 km SW, 225 m, 59732-43; 24 km NE, 150 m, 59731); Sierra de las Minas, 6.4 km N jct CA-9 and rd to San Lorenzo, 500 m (190784-6); 6 km E Zacapa turnoff from CA 9, Río Piedra de Filar, 171 m (187179). UCM: El Quiché: Balejú, 10 air km SW San Cristóbal Verapaz, Alta Verapaz (35023-84, 44571-44606). UMMZ: El Quiché: Sacapulas, 1225-1275 m (120180(3)); Zacapa: Finca San Jorge, 3 km NE Uzumatlán, 600 ft (107072). UTA: Zacapa: Cabañas, Aldea El Rosario (29839). HONDURAS. KU: Choluteca: Choluteca, Agua Caliente de Pavana, El Pital (192322); Comayagua: 13.7 km E Siguatopeque, 1500 m (67286-9); El Paraíso: Guinope, 4.2 km NW, 1435 m (209318-9); 30.6 km NW Mandasta, 1500 m (209320-2); Soledad, Aldea las Marías, Los Canales (192323-4); Intibuca: 15 km E La Esperanza, 1490 m (194331-3); Lempira: betw Gracias and Villa Verde, 1030 m (200579); 3 km N Gualcince, 1510 m (194330); Olancho: 10.5 km S San Esteban, 470 m (200577); Valle: Isla Zacate Grande (194334); Yoro: 2 km S Coyoles, Río Aguán (101442-3); Montaña de Ruidosa, above Calpules, 1000 m (200578). NICARAGUA. KU: Boaco: 3 km E Tuestepe, 160 m (103266);

Carazo: 3 km N, 4 km W Diriamba, 600 m (113006); 1 mi SE Masachapa (42036-44); *Chinandega*: Hda. Bellavista, Volcán Casita, 720 m (101872); 4 km N, 2 km W Chichigalpa (85886-94); San Antonio, 15 m (85896); foothills N slope Volcán San Cristóbal (85963-4). *Chontales*: river 8 km W Muhán (174090-1); 1 km N, 2.5 km W Villa Somoza, 330 m (113004-5); *Estelí*: Estelí (8 km N, 770 m, 67297; 8 mi NNW, 42013; 10 km N, 740 m, 116972-3); Finca Daraili, 5 km N, 14 km E Condega, 940 m (85874-84); *Granada*: Finca Santa Cecilia, 6.5 km SE Guanacaste, 660 m (101871); Volcán Mombacho (174092); *Jinotega*: nr Apanas (174088-9); *León*: Ingenio San Antonio (174082); Poneloya (174080-1); *Managua*: Cerro Coyotepec (174084-5); 23 km N Las Maderas, 394 m (95521-2); Managua (3 mi SW, 42027-35; 6 mi WSW, 42026; 15 km S, 174083); nr Masachapa, 182 m (95523); Sabana Grande (2 km N, 50-55 m, 84869, 85863-8, 85873; 2 mi N, 42120-51; 3 km N, 50 m, 85869-72); 4 mi E San Lorenzo (42017-25); Tipitapa (174086-7; 1 km S, 50 m, 85885); *Matagalpa*: 11 mi SE Darío (42014-6); 3 km NW Sebaco, 440 m (103267); *Rivas*: Finca Amayo, 13 km S, 14 km E Rivas, 40 m (85897-85927); 1-4 km NNE Moyogalpa, Isla Ometepe, 40 m (85895, 85950-62, 85965-9); Río Javillo, 3 km N, 4 km W Sapoa, 40 m (85928-30); 4.5 km E San José del Sur, Isla Ometepe, 60 m (85931-49); *Zelaya*: 3-4 km NNW Puerto Cabezas, rd to Waspán, 30 m (101444).

Sceloporus v. olloporus x *S. v. variabilis* (referred to *S. v. olloporus*). GUATEMALA. KU: *El Progreso*: El Rancho (2 km N, 275 m, 59717-30; N bank Río Motagua across from, 317 m, 18174-7); 27.8 mi SW Río Hondo, Zacapa (157471-2); jct Río Morazán and CA-14, 329 m (187180-2); jct Río Huyus and CA-9, 268 m (187178). UTA: *El Progreso*: El Rancho (7.3 mi W, 8948-9; across Río Motagua from, 20329); Río Morazán, 10.6 km W jct CA-9 and CA-14 (20330-2).

Sceloporus v. variabilis (Northern Gulf Enclave). HIDALGO. JFBM: 7.7 mi S Chapulhuacán (2865). KU: 6 mi NE Jacala (61750); 4 km S Tehuatlán (24255); 5 km S Tehuatlán (23819, 24152, -7, -60, -68, -71, 24253-4, -62, 24381, -6); Río Chinameca, 7.2 km NW Tianguistengo (54056). OAXACA. KU: Vista Hermosa (87395, 87482). UTA: Metates, N slope Sierra de Juárez (11877-82, 24022-39); 1 mi S Valle Nacional (8451-4, 8480). PUEBLA. JFBM: Mesa de San Diego, Rancho El Alengihre (2238). SAN LUIS POTOSI. JFBM: Xilitla rd, 3.3 mi SW Hy 85 (2691, 2694). KU: 11 km N Antiguo Morelos (23310); El Salto Falls (61748, 95525); 1.5 km N Río Frío (95524); 3 mi NE Tamazunchale (61749); Xilitla region (27049-55). UCM: 3.9 mi NE Cd. del Maíz (48963-76); El Salto (28755-65, 28767-72). TAMAULIPAS. JFBM: Rancho del Cielo, Gómez Farías (2233). KU: 1 mi S Altamira (33987-8); 5 mi W Mante (61740-1); 12 mi S Mante (61739, 61742); 24 km N Río Frío (95526); 2 mi W Tampico (61746). VERACRUZ. FMNH: "Otopa" (= Ojapa) (1311(9), 1312(3)); Pérez (1317(5); 1319(11); 1684(10)); San Francisco

(1331(10)). JFBM: 1.8 mi S Buena Vista (9.3 mi N Tlacotalpan), 2852, -8, 2860-1); 2 mi S Tlacotalpan (2865). KU: Alvarado (26736-7, -40, -42-3, -52, -54, -56, -61, -64-6, 27037, 44383); 4 km S Alvarado (59706-10); Boca del Río (26747, 27042); 5 km SW Boca del Río (24338-9, 24348-9, 24351); 13 mi ESE Boca del Río (39687); betw Boca del Río and Veracruz (156260-1); Cerro Gordo, 7 km NNW (23822, 24172, 24250, -70, -72, -77, 24380); Coscomatepec (26738, -63); Cuautlapan (105817, -19-20); 5 km ENE El Jobo (24268); 5 km N Jalapa, 4500 ft (24333-7, -42-4, -50, -52-3); 17 km SE Las Trancas, Hy 140 (95527-31); Mirador, 3500 ft (23823, 24261, 24385); Mocambo Beach (158788); 9 km NW Nautla (24164, 24265, -74); 4 km W Paso de San Juan (24159, 24251, -7, -76); 20 km WNW Piedras Negras, Río Blanco (23256, -62-3, -5-7, 23309, -11, 24256); 3 km W Plan del Río (24346); 5 km W Plan del Río (24340-1); 5 km S Potrero, 1700 ft (26739, -50, -7); 8 km S Potrero, Sala de Agua, El Maguey (23308); 13 km WNW Potrero, 2000 ft (26748, -51); Potrero Llano, 350 ft (27040); Potrero Viejo, 1700 ft (24153, -74, 24378, 26735, -41, -60); Puente Nacional (24252, 27034, -9); 8 km NW Rinconada, Hy 140 (95532); 15 km ESE San Juan de la Punta (24345, -7); 3 km SW San Marcos (23820-1, 24156, -8, -63, -5, -7, -9-70, 24263, -6, -73, 24389); 10 mi WNW Temapache (61732-8); Teocelo (26749, -55, -8-9, -62, 27035-6, -8); 15 km ENE Tlacotepec, 1500 ft. (24166, 24258, 24387); 4 km W Tlapacoyán, 1700 m (24155, -61, -73, 24259, 24388). MZFC: Punta Arenas, 6 km N Lerdo de Tejada (FMQ 2141-3); 1 km S Mocambo (220). UCM: 1.1 mi SW Acutlzingo (48393-4); 15 mi N Alvarado (50767); El Morro Lighthouse (39455-9); La Palma, Mpio. Totutla, 1200 m (30350-2); 1 mi N Punta del Morro (38365-72); 18.6 mi W Rinconada (48395-9); beach 5 mi S Salinas (39460-72); 4 mi S Tecolutla Ferry (39454); coast rd 20 mi SE Veracruz (45615). UIMNH: 5.3 mi N Antón Lizardo (40221-35).

Sceloporus v. variabilis (Southern Gulf Enclave). TABASCO. MZFC: Punta Sur de Sánchez Magallanes (FMQ 2198-2205); Ejido El Alacrán, 20 km ESE Sánchez Magallanes (FMQ 2206). UCM: 5 mi W Frontera, Playa Miramar (39415-53). UIMNH: 11 km SW Frontera, Playa Miramar (87382-99); Sánchez Magallanes (87368-81).

Sceloporus v. variabilis (Chiapas, Oaxaca, Guatemala Enclave). CHIAPAS. KU: Río Jesús, 32 km NW Pijijiapan (67283); Linda Vista, 2 km NW Pueblo Nuevo Solistahuacán (59747); 12.8 km ESE Teopisca (187187-8). MZFC: 10 km NE Frontera de Comalapa (FMQ 2235-7). UCM: Mt. Ovando (39673-4); 6.4 mi N Tuxtla Gutiérrez (48954-8); 15.3 mi N Tuxtla Gutiérrez (48959-61). UIMNH: 15 mi S Pichucalco (8898-9); 13 mi S La Trinitaria (8997). UMMZ: Arriaga (88404); Bochil (99850); 35-36.2 mi S Jitotol (119850(3), 119851(2), 119852(4)). UTA: 11.3 km ESE Teopisca, 2073 m (33632); Teopisca (6.4 mi ESE, 6088-93; 10.3 km ESE, 5762-3; 10.5 km ESE, 11862; 11.3 km ESE, 11863-7); Tulanca, 12.1 km ESE Teopisca

(11872-4); Tulanca quarry (24040-1); 1 mi W Tulanca (8929-31); 1.1 mi E Tulanca (8927-8, 8950). OAXACA. AMNH: Cerro Atravesado, 4000 ft (66894); Río Chicapa, nr Cerro Atravesado, 1800 ft (66939). FMNH: Niltepec (1468, 99251-2). MCZ: Tapanatepec (33454-5). UIMNH: Niltepec (21954); Plan de Campaña, Río Porto Moneda (37256, 37264). UTA: Cerro Baul (5674). GUATEMALA. KU: Huehuetenango; El Tapón, 1390 m, 33 km WNW Huehuetenango (116960-2).

Sceloporus v. variabilis x *S. v. olloporus* (referred to *S. v. variabilis*). CHIAPAS. KU: 22.8 mi SE Comitán, Hy 190 (145231); Las Margaritas (94103). UCM: 15.8 mi SE Comitán (48950); 22.8 mi SE Comitán (48951-3); 41 mi S Comitán (18985). GUATEMALA. KU: Totonicapán: Santa Lucía La Reforma, 1700 m (1 km E, 190793; 4 km N, Sacsiguán, 190791-2; 8 km NW, Río Sajcoclaj, 190790).

Table 1. Occurrence of Selected Character States in Members of the *Sceloporus variabilis* Complex*

Character	TOV	TNOV	TT	VNGN	VNGS	VNGT	WSG	VVOG	VVT	VON	VOS	VOT	VM	S
Rump Rows														
N (mean)	146 (8.8)	166 (9.2)	312 (9.0)	247 (10.9)	39 (10.0)	286 (10.8)	70 (10.2)	66 (11.0)	422 (10.7)	190 (11.0)	264 (11.0)	454 (11.0)	45 (12.5)	34 (12.0)
range	7-11	8-11	7-11	9-13	8-11	8-13	9-11	10-13	8-13	10-13	9-12	9-13	11-15	11-14
< 10%	91	80	85	5	18	6.3	7	0	5	0	0.4	0.2	0	0
< 11%	99	99	99	29	79	36	73	20	40	24	11	16	0	0
< 12%	100	100	100	78	100	81	100	83	84	81	84	82	13	15
10-11%	9	20	15	74	82	79	93	83	79	81	84	83	13	15
12-15%	0	0	0	22	0	19	0	17	16	19	16	17	87	85
> 9%	9	20	15	95	82	94	93	100	95	100	99.6	99.8	100	100
Nape Rows														
N (mean)	140 (10.6)	159 (11.2)	311 (11.0)	249 (14.1)	38 (13.3)	287 (13.9)	70 (13.4)	63 (13.3)	420 (13.7)	188 (12.9)	257 (13.2)	445 (12.8)	43 (16.0)	34 (15.0)
range	9-13	9-13	9-13	11-17	11-16	11-17	12-15	11-15	11-17	11-16	11-15	11-16	14-18	13-17
< 12%	82	71	78	0.4	11	2	0	2	2	4	1	2	0	0
< 13%	96	99	99	5	16	6	20	27	14	41	22	30	0	0
9-10%	41	13	26	0	0	0	0	0	0	0	0	0	0	0
12-15%	18	28	92	87	87	91	100	98	94	96	97	97	33	77
15-18%	0	0	0	32	11	29	4	8	17.5	4	2	3	84	50
Rump-Nape Rows														
16-21%	95	89	92	0.8	13	3	4	0	3	3	1	2	0	0
16-22%	99	99	99	8	24	10	23	11	12.3	20	10	14	0	0
Rump-Nape-Canthosubnasale														
20-26%	90	93	91	1	11	3	1	3	2	2	1	1	0	0
20-27%	97	98	97	3	13	4	9	10	6	11	3	7	0	0
20-28%	99	100	99.7	11	26	13	24	21	16	26	12	18	0	3
> 27%	3	3	3	97	87	96	91	90	94	89	97	93	100	100
Canthosubnasale														
N	290	315	605	493	78	571	140	132	843	352	520	872	85	68
2%	61	86	74	8	6	8	6	21	10	13	7	10	31	6
3%	39	14	26	92	94	92	94	79	90	87	93	90	69	94
Postrostrals														
N	145	161	306	248	38	286	70	62	418	188	258	446	44	34
range	2-5	2-4	2-5	2-6	2-4	2-6	2-4	2-4	2-6	2-5	2-4	2-5	2-4	3-5
> 3%	86	81	83	85	84	85	83	92	86	78	32	51	77	94

*S. S. smithi, TNOV, S. teapensis exclusive of Oaxaca, Veracruz; TOV, S. teapensis, Oaxaca, Veracruz; TT, S. teapensis, all; VM, S. v. marmoratus; VON, S. v. olloporus, Guatemala, El Salvador, Honduras; VOS, S. v. olloporus, Nicaragua, Costa Rica; VOT, S. v. olloporus, all; VVOG, S. v. variabilis, Chiapas, Oaxaca, Guatemala; VVNGN, S. v. variabilis, northern part of Northern Gulf enclave; VVNGS, S. v. variabilis, southern part of Northern Gulf enclave; VVNGT, S. v. variabilis, Northern Gulf enclave, all; VVSG, S. v. variabilis, Southern Gulf enclave.



Fig. 1. Right groin of *S. teapensis*, UCM 28796, male, 59 mm s-v, Coyame, Lake Catemaco, Veracruz. Thigh to the right.

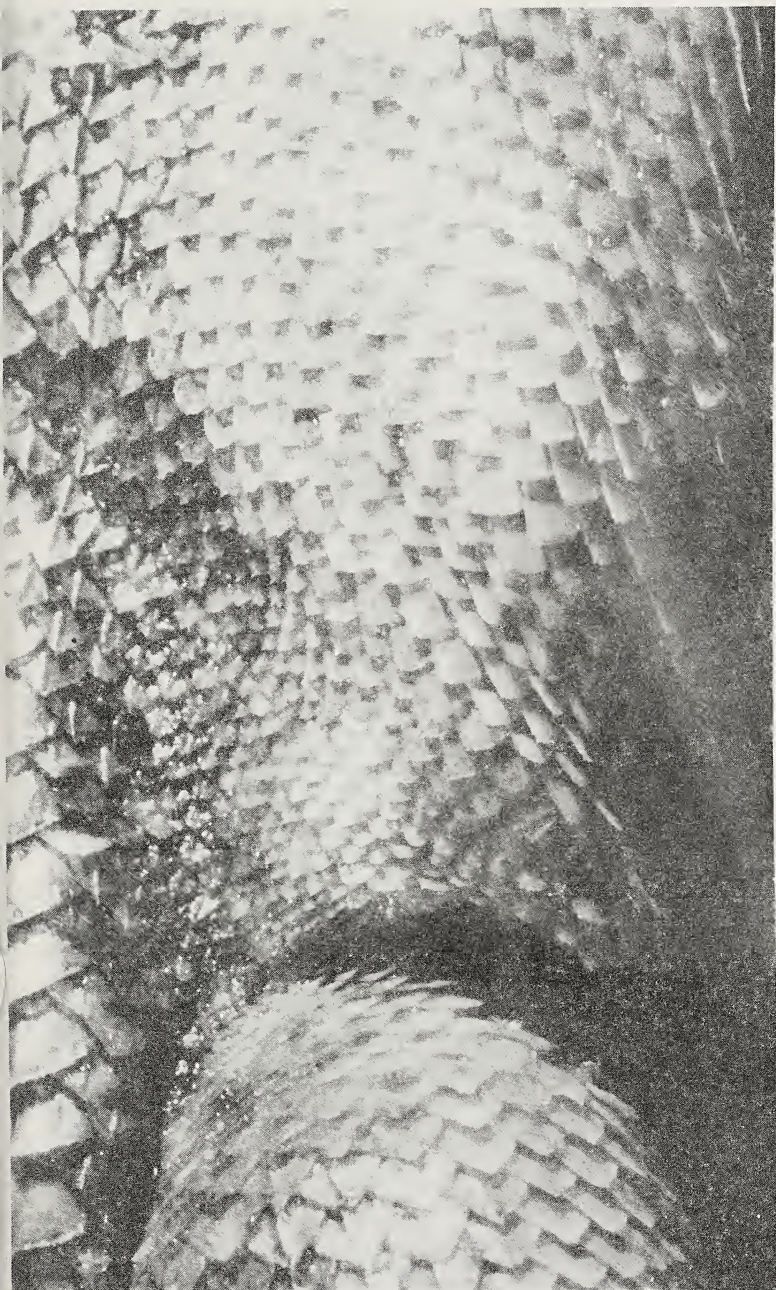


Fig. 2. Right groin of *S. v. variabilis*, UCM 39467, male, 55 mm s-v. 5 ml S Salinas, Veracruz, on beach (about 45 road mi SE Cd. Veracruz). Note the much smaller groin scales than in *S. teapensis*, yet the specimen has the large dorsal scales typical of the latter species (44 dorsal count, 9 rump rows, 11 nape rows). The series of 13 from that locality (UCM 39460-72) contains eight with 49 or fewer dorsals (52 the maximum), and three have 8 or 9 rump rows. Although those features suggest intergradation with *S. teapensis*, all have small inguinal scales, and on only one side of one are there but two (instead of three) canthosubnasals. We interpret these variations in this series, and in some other similar series from nearby localities, as indicative of hybridization at least in the past, with limited introgression.



Fig. 3. Auriculobranchial region of *S. v. variabilis*, same specimen as in Fig. 1. Base of foreleg at lower left, bordered anteriorly by the lateral nuchal fold, covered with large scales overlapping the subgranular ones.



Fig. 4. Auriculobranchial region of *S. v. variabilis*, same specimen as in Fig. 2. Lower edge of lateral nuchal fold at lower right center. Note that the scales are reduced in size between the edge of the fold and the lateral row of dorsal nuchals, whereas in *S. teapensis* they are of more or less equal size over the entire fold.

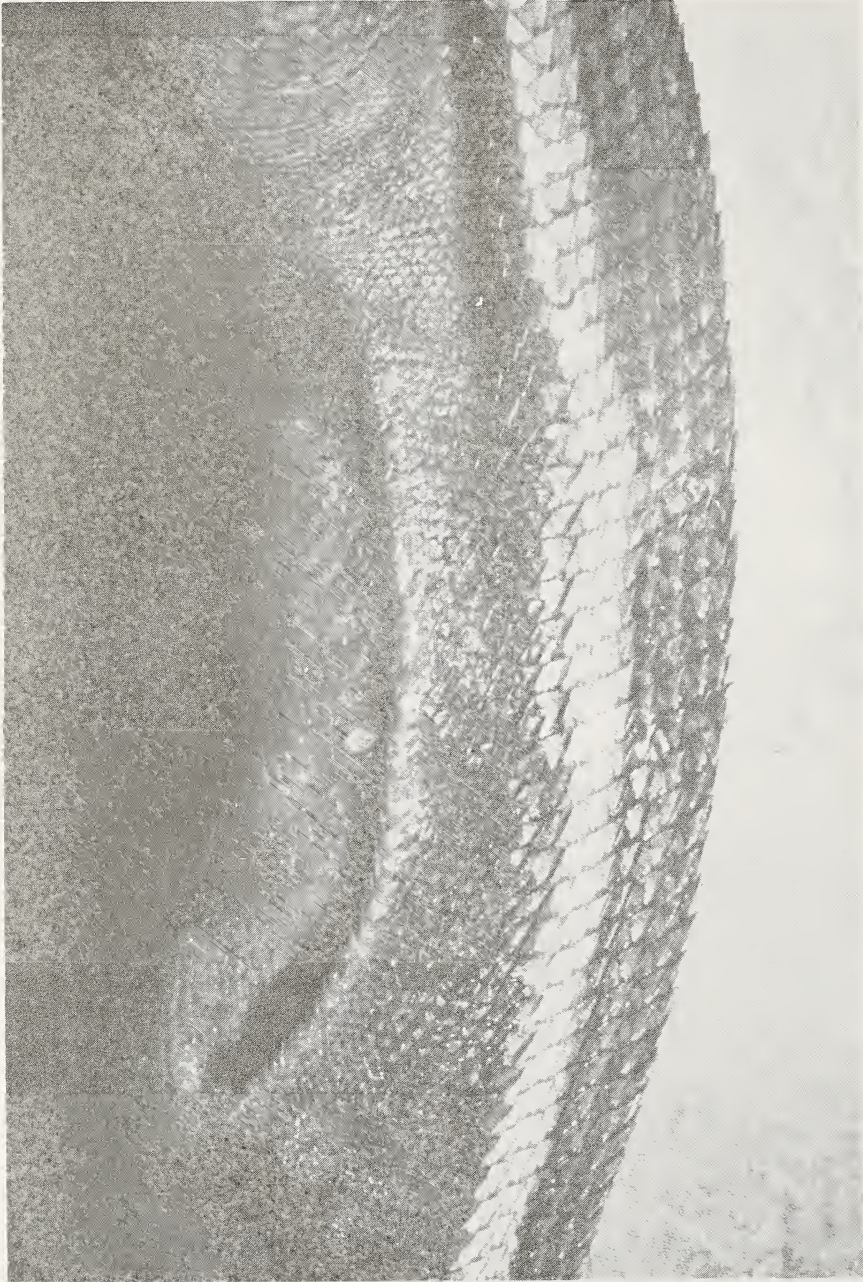


Fig. 5. Right side of abdomen of *S. smithi*, AMNH 66897, male, 68 mm s-v, nr Tehuantepec (an unintelligible "Labos Sepas"), Oaxaca, showing the distinctive, curved ridge extending from near the groin to the lower margin of the axilla.

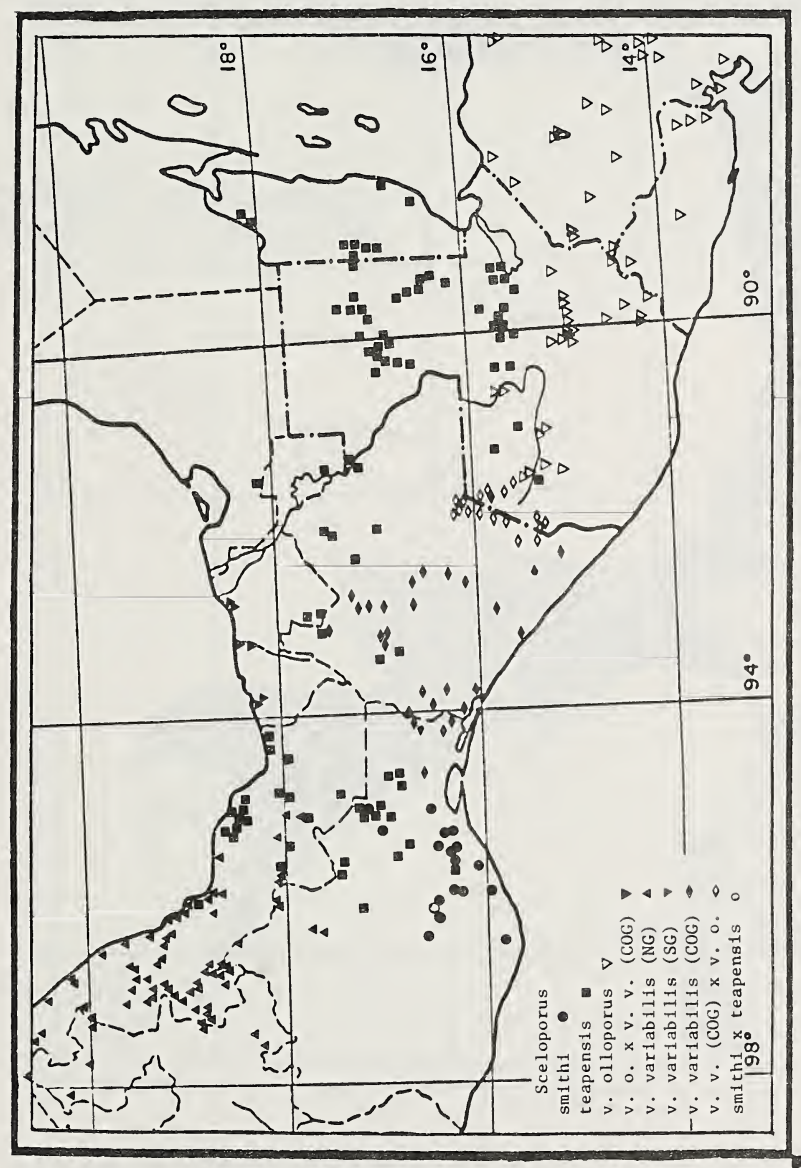


Fig. 6. Spot map showing localities of record in southern Mexico and adjacent Central America for members of the *Sceloporus variabilis* complex, gleaned from the literature, specimens examined, and lists of holdings in various museums.

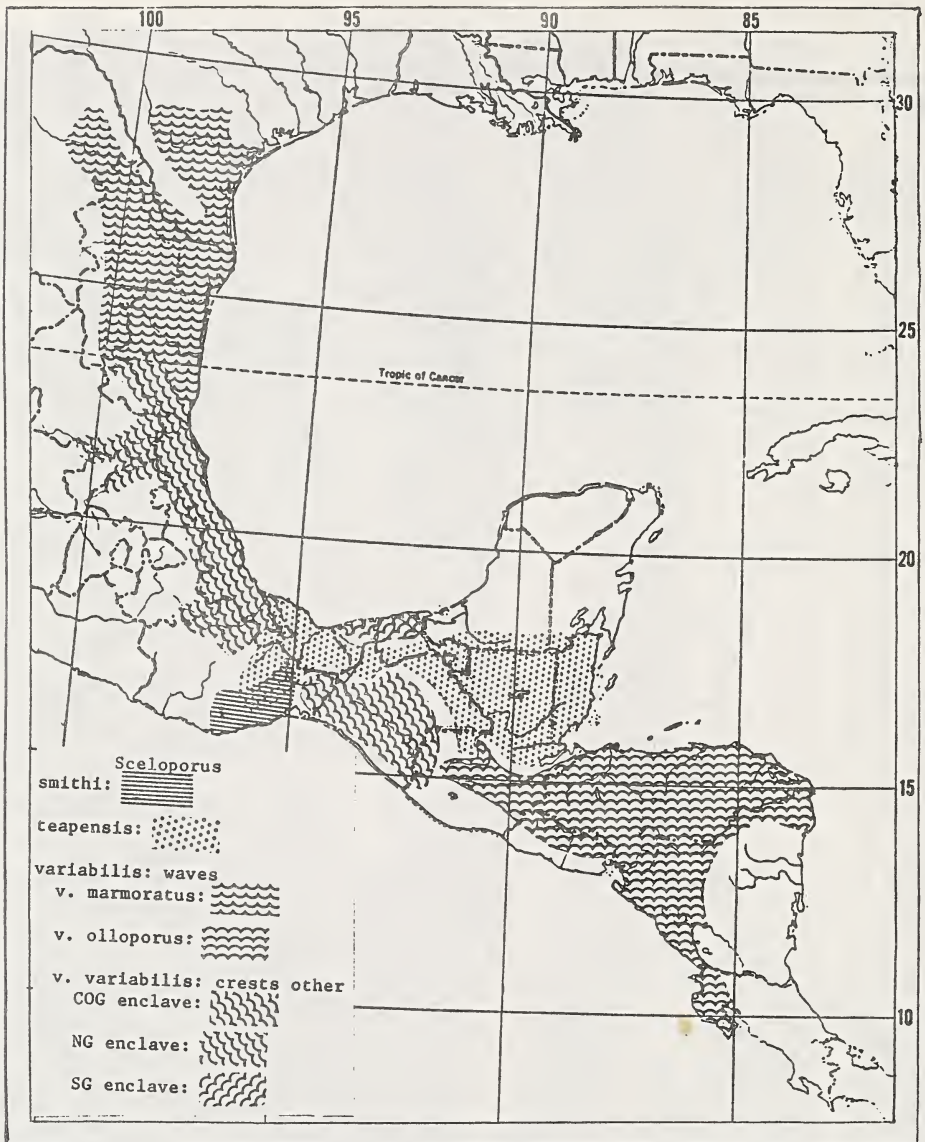


Fig. 7. General distribution of members of the *Sceloporus variabilis* complex. Gaps between ranges reflect chiefly absence of records; contacts, intergradation, hybridization or sympatry may occur there. Most problematical are the ranges and interactions of the two subspecies of *S. variabilis* in central and western Guatemala.

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THE GENERIC ALLOCATION OF *TANTILLA CANULA* (REPTILIA: SERPENTES)

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Tantilla canula has all maxillary teeth subequal in size and shape, none enlarged or grooved. Those features place it in the genus *Tantillita*, extending its diagnostic parameters in range of variation of maxillary teeth from 21-25 to 15-25. The three species of that genus form a compact geographic unit and retain numerous primitive character-states that presumably were found in the common ancestors of the two genera.

The catalog of the herpetological collection in the Museo de Zoología of the Facultad de Ciencias (MZFC), Universidad Nacional Autónoma de México (Flores et al., 1991) contains an entry for *Tantillita lintoni* from Cd. Mérida, Yucatán, although without catalog number. Inasmuch as that species had not previously been recorded from the Yucatán Peninsula, the material was reexamined. It actually consists of two specimens, which prove to be referred correctly to *Tantillita*, but they represent the species named long ago *Tantilla canula* by Cope (1875; not 1876 fide Osborn, 1930).

The two specimens, MZFC 940, both females, were taken in August, 1974, in Mérida, Yucatán, by Alfredo Barrera Vázquez. The larger of the two, 172 mm tl, tail 30 mm but extreme tip missing, has 116 ventrals and 35+ subcaudals; the smaller, 81 mm tl, tail 7 mm but much missing, has 114 ventrals and 17+ subcaudals. A median light line extends the full length of body and tail in the juvenile, but is visible in the adult only dimly on the neck and distinctly on the tail. In both specimens the vertebral stripe abruptly is brighter at the base of the tail, continuing to the tip, as though unaffected by the progressive fading with age on the trunk. A dim dark line, more distinct in the juvenile, follows the third scale row and is less evident anteriorly, especially in the adult; very faint lines or series of dark dots follow parts of some other scale rows. The peculiar light areas on the snout, parietals and other head scales, as well as all other features of the pattern, conform in detail with the description of the species in Wilson (1982a: 21-22, 25-29).

However, the allocation of the present specimens to *T. lintoni* was a result of examination of the teeth, which conform completely with those of *Tantillita* in being of essentially the same size throughout, and none being

distinctly enlarged, grooved or offset. The only difference from the maxillary teeth of the two previously recognized species of *Tantillita* is their small number -16 (as counted on both maxillae of the larger MZFC specimen) - whereas the other species have 21-25 (Wilson, 1988b).

Yet inclusion of *T. canula* in *Tantillita* does not expand the parameters of the latter's diagnosis (Wilson, 1988b) in any way except for the range in number of maxillary teeth, 21-25 to 16-25. On the contrary, inclusion of *T. canula* in *Tantillita* makes good sense in all other ways: all three species are closely associated geographically in or near the base of the Yucatán Peninsula, are of small size (maximum 200 mm tl; Wilson and Meyer, 1985: 104), have few ventrals (103-125; Wilson, 1988a, b), few subcaudals (28-56; Wilson, 1988a, b), basically the same cephalic scutellation, and little variation in pattern. The three species appear to form a closely related unit.

The correct relation of *T. canula* to *Tantillita* rather than to *Tantilla* would no doubt have been realized long ago if it were not for the erroneous report by Smith (1941:116) that "In *T. canula* the fangs are twice as long as the other teeth, deeply grooved..." The number given (p. 115) of maxillary teeth for the species is but one less (15) than the number in the MZFC specimen, but the latter definitely has no enlarged or grooved teeth. Inasmuch as Smith's figures were based upon one of a series of three that Cope examined in describing the species (although Cope only mentioned two), a resolution of the disparity was imperative. Dr. Robert P. Reynolds kindly provide it by examining the specimen studied by Smith (USNM 24880) as well as the two syntypes of *T. canula* (USNM 24881-2). He reported (in litt., Jan. 19, 1993) that "I have looked at the posterior maxillary teeth in all three specimens and find that they are only slightly larger than the preceding teeth. Also, under 40x magnification, I cannot see a groove on these teeth."

Therefore the specimens here reported of *Tantillita canula* do not differ significantly from others of the species; in that species the posterior maxillary teeth are not "deeply grooved" or "their size...little more than twice that of the others," as reported by Smith (1941: 116). We have however accepted the number of maxillary teeth given there as correct since it is but one less than the number in the Mérida specimen,

The small size, numerous and unspecialized maxillary teeth, and few ventrals and subcaudals of *Tantillita* are all plesiomorphic character-states relative to *Tantilla*. Coloration may also be regarded as plesiomorphic, representing the three pattern types (Wilson, 1982b) characteristic of species of *Tantilla* from Mexico northward; unicolor (*T. lintoni*), collared (*T. brevissima*), and striped/head-patterned (*T. canula*). The cross-barred pattern of some more southern *Tantilla* is not represented in *Tantillita*.

It appears that *T. canula*, with its reduced number of maxillary teeth and complex pattern, is the most derived of the three species of its genus; the other two species are derived in some respects (the nuchal collar in *T. brevissima*, large size and numerous subcaudals in *T. lintoni*), primitive in others (numerous maxillary teeth in both; patternless condition in *T. lintoni*).

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THE STATUS OF THE MEMBERS OF THE *SCELOPORUS AENEUS* COMPLEX (REPTILIA: SAURIA) OF MEXICO

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Sceloporus aeneus subniger is a valid subspecies occurring throughout most of the range of the species, including extreme eastern central Hidalgo and adjacent Puebla, where it occurs in gross sympatry with *S. bicanthalis*. *S. a. aeneus* is limited to the southeastern part of the range of the species. The viviparous population of the *S. aeneus* complex on the Nevado of Toluca also is *S. bicanthalis*, occurring above 3000 m; it constitutes the westernmost known range limit of the species. *S. a. subniger* occurs at lower elevations there and elsewhere. Presence of gular dark bars is not diagnostic of either *S. a. subniger* or *S. bicanthalis*, but their nature (longitudinal, transverse or absent) and number of canthals (two or one), as well as parity type, distinguish the two from each other. Both the canthal character and the nature of the gular bars require special attention for proper interpretation. It appears likely that *S. bicanthalis* occurs at lower elevations where it is not grossly sympatric and presumably competitive with *S. aeneus*; the vertical ranges of both species may be limited in sympatry. The complex provides fascinating opportunities for comparative ecological and ethological research.

The proper interpretation of "*Sceloporus aeneus subniger*" Poglayen and Smith (1958) involves two problems as yet in limbo: the identity of populations of the *S. aeneus* complex (1) on the Nevado de Toluca, state of Mexico, and (2) at the type locality (63 km N Cd. Toluca) of that nominotaxon. Inevitably, the relationships of these populations to the other members of the complex (*S. a. aeneus* Wiegmann and *S. bicanthalis* Smith) are here considered in conjunction with the two stated problems, and together reveal fascinating problems of competitive exclusion.

The History of the Interpretations of the Nevado de Toluca Populations. The identity of the populations of the *S. aeneus* complex on the Nevado de Toluca has been uncertain ever since viviparity (a characteristic of *S. bicanthalis*) was discovered there in association with a supposedly single canthal (a characteristic of *S. aeneus*) and barred chin/gular markings (supposedly characteristic of *S. bicanthalis*) (Guillette and Smith, 1985: 8). These features were recorded on the basis of verbal reports from other workers, not from material examined by Guillette or Smith. However,

confirmation of occurrence of a single canthal in specimens from there was provided implicitly by assignment of material without comment to *S. a. aeneus* by Smith (1939: 356), and explicitly by others who had seen the specimens. The viviparous Toluca population was therefore regarded as a distinct species by both Guillette and Smith (1985) and Camarillo (1990), combining features of *S. aeneus* (single canthal) and *S. bicanthalis* (viviparity, barred chin).

The name *S. subniger* was applied by those authors to the Nevado de Toluca viviparous species simply because its type locality is nearby, a single canthal occurs in it, and no comparative material was at hand to confirm or reject that allocation. On the basis of this assumption, Camarillo (1990) hypothesized that viviparity evolved at least twice independently in the *S. aeneus* complex, giving rise to *S. bicanthalis* toward the east, "*S. subniger*" toward the west.

Two Species, not One, of the S. aeneus Complex on the Nevado de Toluca. It is now apparent that two taxa of the *S. aeneus* complex occur on the Nevado de Toluca. The viviparous population, as pointed out by Camarillo (1990), is limited to a vertical range of 3000-4500 m, whereas the oviparous population occurs in the 2000-3000 m range. Therefore the name *subniger*, based on a population occurring well below 3000 m and about 75 km north of the Nevado de Toluca, cannot apply to the viviparous population on that mountain, the only eminence in the area reaching elevations greater than 3000 m. If the viviparous population on the Nevado were taxonomically distinct, it would require a new name.

Sixteen specimens representing the viviparous population of the Nevado de Toluca (ENEPI - Escuela Nacional de Estudios Profesionales Iztacala - 937, 3811-6, and nine untagged, captive-born young) have been examined, and to our surprise all have two canthals on both sides, as well as the typical *S. bicanthalis* pattern, both dorsal and ventral. That population is clearly representative of the same viviparous species, *S. bicanthalis*, that occurs so widely to the east, in isolated populations at high elevations. The Nevado population constitutes the westernmost outpost of the species known at the present time.

Comparisons of the Two Species of the S. aeneus Complex on the Nevado de Toluca. One of the prime reasons for uncertainty of identity of populations of the *S. aeneus* complex on the Nevado de Toluca is the fact that in both the viviparous and oviparous populations a black-barred throat occurs - a feature commonly regarded as a distinctive character-state of *S. bicanthalis*.

There are five distinct difference in that marking, however, between the two species (Fig. 1). (1) In every individual of *S. bicanthalis* the chin/gular bars are sharply defined, in both sexes; in *S. a. subniger* (subspecific allocation discussed in following section) only males have distinct gular bars, and even in them no bars are evident in the occasional large adult that is wholly black ventrally, or in juveniles, whereas in females the throat pigmentation is diffuse, with poorly defined pattern. (2) In *S. bicanthalis*, the gular bars are sharply defined throughout life, from neonates to the largest adults, whereas in *S. a. subniger* no barring at all is evident in hatchlings, is weakly evident in females, and in males may be lost as the whole ventral surface of head and body becomes black. (3) In *S. bicanthalis*, the ventral surfaces never become entirely black, although in *S. a. subniger* old males occasionally do (regularly in *S. a. aeneus*). (4) In *S. bicanthalis* the gular/chin bars are longitudinal, not transverse or reticular, whereas in *S. a. subniger* they are basically transverse or reticular. (5) The dark longitudinal streaks extend onto the chest and even down the middle of the abdomen and onto the ventral surfaces of the limbs in *S. bicanthalis*, whereas in *S. a. subniger* the streaks end abruptly with the gular region.

In other words, it is insufficient, in distinguishing the two species on the basis of the throat bars, to rely simply on their presence or absence; if absent, the species is *S. aeneus*; if present, the species is *S. bicanthalis* if the bars are sharply defined, extensive and longitudinal, but *S. a. subniger* if they are diffuse, limited to the throat, and/or basically transverse or reticular. These differences are, of course, correlated with a seemingly infallible difference in parity type and number of canthals - viviparity and two in *S. bicanthalis*, oviparity and one in *S. aeneus* - but the latter character also requires special attention to its variation of expression (see account for *S. bicanthalis*).

The Status and Range of S. a. subniger. The subspecies *S. a. subniger* has never been properly understood, in the absence of an adequately comparative analysis. It was named primarily upon the basis of a good series of 50 specimens, most from west-central Mexico (state; 63 km NW Cd Toluca, the type locality, 8; 15 km W Toluca, 25; El Cerrillo, about 25 km NW Toluca, 1); others included one from Irapuato, Guanajuato, and nine "intergrades" from the Nevado de Toluca. The latter obviously cannot be intergrades, but may have been so considered if some specimens of *S. bicanthalis* were among them.

We have examined several others belonging to the same subspecies: ENEPI 3818-25, Mayorazgo de León, Mexico (state; about 16 airline km SW type locality); ENEPI 307, 312, 314-6, 323-4, Presa Tejocotal, about 35 km NE Tulancingo, Hidalgo; KU 29135-7, 29139, 1 mi SSW Salazar, 15 mi W Cd.

Toluca, 9500 ft; KU 39879-82, 1 mi W Salazar, 9850 ft; KU 43657-8, 14 mi NW Toluca; KU 38112-5, 1.5 mi NNW Tenango, 8530 ft (40 km SE Toluca); KU 38116, 10 mi N, 6 mi E Valle de Bravo, 7460 ft (76 km W Toluca). One of us (JLCR) has observed the subspecies also at Presa Omiltemetl, 6-8 km N Presa Tejocotal. Direct comparisons were made with examples of *S. a. aeneus* from Lagunas de Zempoala, Mexico (state; UCM 6795), 1.5 mi NW Tres Cumbres, Morelos (UCM 6780), and 23.4 mi N Cuernavaca, Morelos (UCM 47113-4); all have a single canthal.

These specimens and reports in the literature (especially Guillette and Smith, 1985, and Smith, 1939) make it apparent that *S. a. subniger* differs sharply from *S. a. aeneus* in occurrence of a black-barred or mottled chin/throat in both sexes (except for males in which the progressive melanization of ventral surfaces with increasing age has left them all black) (in *S. a. aeneus* the chin/gular region is never barred or mottled in either sex; pigment is more or less evenly dispersed as pointed out by Guillette in Guillette and Smith, 1985, on the basis of hundreds of specimens he examined from the perimeters of the Valley of Mexico); the better developed abdominal semeions (in *S. a. aeneus* the ventral surfaces melanize rather uniformly, with no or little pattern; the abdominal semeions are poorly defined or absent); and the infrequent total melanization of ventral surfaces (in *S. a. aeneus* males, total melanization of the ventral surfaces occurs regularly). Most of the range of the species is occupied by *S. a. subniger*, leaving *S. a. aeneus* in the extreme southeastern part, including extreme southeastern Mexico (state), adjacent Morelos, northern central Puebla and possibly Tlaxcala. The description of the specimens from 14 km S Huauchinango, Puebla (Smith and Brandon, 1971) indicates that they represent *S. a. subniger* as at present understood, not *S. a. aeneus*. Presumably those reported from Piedras Encimadas, Puebla (Guillette and Smith, 1985: 8), "southeast" of the preceding locality, is the same. The "Omiltepec", Hidalgo, of specimens reported in the latter work probably refers to Presa Omiltemetl, hence the specimens represent *S. a. subniger*.

The northernmost record for the subspecies is San Felipe, Guanajuato (Smith, 1939). The easternmost is in the area around Huauchinango, Puebla, and the southernmost is in the vicinity of the Nevado de Toluca. To the west, Paracho, Michoacán (Duellman, 1961: 66), marks the limit based on reliable identification; Boulenger's (1897) records for Jalisco ("north of Rio Santiago"; "La Cumbre de Los Arrastrados") appear to be too far west to be accepted without verification, although the subspecies very likely occurs in extreme northeastern Jalisco, and perhaps in adjacent Aguascalientes and San Luis Potosí. The accompanying map (Fig. 2) plots all localities authoritatively known to us for the *S. aeneus* complex; especially important sources are the works by Duellman (1961), Flores et al. (1991), Guillette and

Smith (1985), Smith (1939) and Thomas and Dixon (1976). Unfortunately accuracy is not a certainty even among these sources, without enlightened re-examination, particularly of material from Tlaxcala and Puebla.

There is much more gross overlap in the ranges of *S. a. subniger* and *S. bicanthalis* than has generally been assumed, from the Nevado de Toluca in the west to the vicinity of Huauchinango in the east (Guillette and Smith, 1985: 8). The northeasternmost record for both *S. bicanthalis* and *S. a. subniger* is from Zacualtipán in extreme eastern Hidalgo. The throat/chin in the series of the latter subspecies from the nearby Presa Tejocotal is as strongly mottled or barred as in the series from near the type locality, at Mayorazgo de León, Mexico (state), and that pattern is regularly present in all of the other series reported here.

S. bicanthalis Characteristics. Comparisons of *S. bicanthalis* and *S. a. subniger* are given in a preceding section. The latter taxon is much more easily confused with *S. bicanthalis*, because of its barred chin/gular pattern, than is *S. a. aeneus*, with its patternless throat. The most useful scale character, seemingly infallible, is the presence of two canthals in the former, one in the latter. However, difficulties can be experienced in the use of this character because of variation in position of the anterior canthal. Although in most specimens of *S. bicanthalis* both canthals lie on the canthal ridge and hence are readily recognized as such, frequently the anterior canthal lies wholly above that ridge and is therefore easily overlooked and regarded as absent. Intermediate positions also are present. Therefore any specimen that has but one scale on the canthal ridge, between nasal and superciliary, should be examined for the presence or absence of a relatively large scale on the dorsal surface in contact with the subnasal-posterior canthal suture, and extending usually all the way between the lateral frontonasal (which is occasionally split) and the subnasal. If present, the specimen represents *S. bicanthalis*. In *S. aeneus*, no such large scale is present; a single, enlarged canthal extends along the entire canthal ridge, and no good-sized scale lies between it and the nasal.

Sympatric Interaction and Dichopatric Freedom. The altitudinal separation of *S. aeneus* and *S. bicanthalis*, with little or no overlap, is well-documented in areas carefully studied where the two species are grossly sympatric, such as the Nevado de Toluca, and elsewhere in the states of Mexico, Morelos and Puebla, and in Distrito Federal (Guillette and Smith, 1985: 2, 8). Along the Sierra Madre Oriental, *S. bicarinatus* is recorded from as far north as Zacualtipán, Hidalgo, and at several localities as far south as Mt. Zempoaltepec, Oaxaca, whereas *S. aeneus* is known within that range only from Zacualtipán, Presa Omiltemetl (present report; Guillette and Smith, 1985: 8, as Omiltepec) and Presa Tejocotal (present account),

Hidalgo, and from the Huauchinango area (Smith and Brandon, 1976), including Piedras Encimadas (Guillette and Smith, 1985: 8), and Totolapa (Flores et al., 1991: 110), as well as the southeasternmost known locality of record, at Chignahuapán, where *S. bicanthalis* is also recorded (Flores et al., 1991: 110-111), Puebla (Fig. 2). Therefore some gross sympatry of the two taxa apparently occurs in eastern Hidalgo and northern Puebla, but records for *S. aeneus* are scarce, and comparative altitudinal studies have not yet been carried out there. Some localities from which *S. bicanthalis* has been recorded, if correct, are at considerably lower elevations (e. g. Zacualtipán, at 2020 m) than others where the species has been recorded in the western part of its range in gross sympatry with *S. aeneus*. It remains to be determined whether *S. bicanthalis* occurs at lower elevations where *S. aeneus* does not exist; fragmentary data now available suggest that that may be the case. Competition where gross sympatry occurs may limit the vertical ranges of both species; an over-all survey is much to be desired.

The eastern distribution of both species is poorly known, with an especially large gap between Mt. Orizaba, Veracruz, and Mt. Zempoaltepec, Oaxaca, with only one record, from Reyes, Oaxaca, for *S. bicanthalis* (Fig. 2). Additional field studies will be necessary to establish definitively the ranges, both vertical and horizontal, of the two species, in sympatry and in dichopatry - problems of considerable general as well as specific interest.

Key Correction. The key to the members of the *Sceloporus scalaris* group given in Guillette and Smith (1985: 14-15) can be corrected to date by adding "oviparous" to the first half of couplet 2, and in couplet 5 by deleting the words "viviparous" and "oviparous," and adding "*aeneus*" as the specific name for both "*subniger*" and "*aeneus*."

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Fig. 1. Ventral views of adult males of *S. a. subniger* (one on left, two on right) and *S. bicanthalis* (second from left). Left to right, ENEPI 3819, 52 mm s-v; ENEPI 3814, 45 mm s-v; ENEPI 3823, 54 mm s-v; and ENEPI 323, 44 mm s-v. See text for localities.

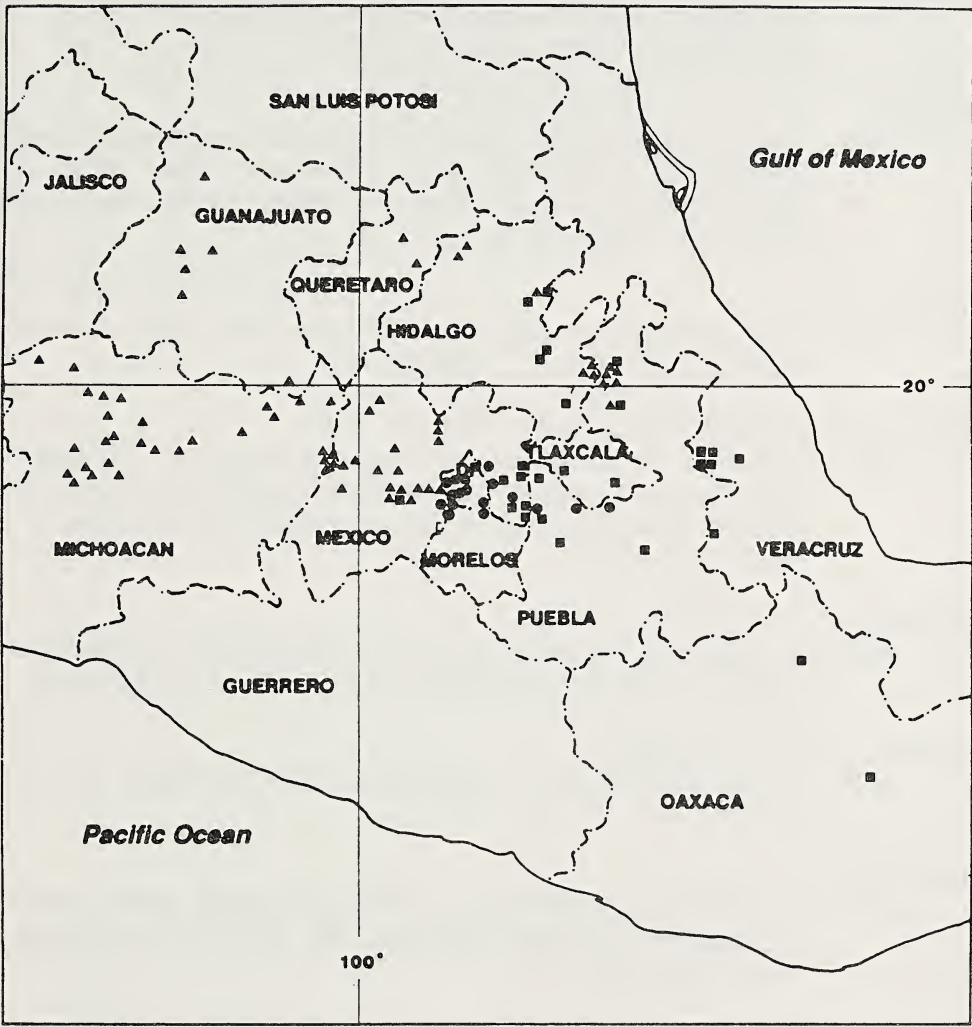


Fig. 2. Locality records for *S. bicanthalis* (square dots), *S. a. aeneus* (round dots) and *S. a. subniger* (triangular dots).

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NOTES ON HIBERNATION OF THE SMOOTH GREEN SNAKE *OPHEODRYS VERNALIS*, IN NEW MEXICO

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The few records available on hibernation of the smooth green snake (*Opheodrys vernalis*) list inactive ant mounds (Criddle, 1937; Carpenter, 1953; Lang, 1969) and possibly small mammal burrows (Johnson, 1987) as hibernaculum sites. Very little life history data are available for this species in the southwestern portion of its range where it occurs primarily in mesic montane habitat. In this note, we describe a small hibernaculum in the Sangre de Cristo Mountains of northcentral New Mexico that was used by *O. vernalis* and two other reptile species.

On 20 February 1992, a small hibernaculum containing several torpid individuals of *O. vernalis*, the many-lined skink (*Eumeces multivirgatus*), and the wandering garter snake (*Thamnophis elegans vagrans*) was discovered during construction of a building foundation by personnel at the Randall Davey Audubon Center, 4.5 km E center of Santa Fe, Santa Fe County, New Mexico (35 deg 41' N, 105 deg 53' W). A group of five *E. multivirgatus* and one *T. e. vagrans* was uncovered when a large, partially buried boulder was overturned. A second group of reptiles consisting of an unknown number of *O. vernalis*, an *E. multivirgatus*, and two juvenal *T. e. vagrans* was found ca. 30 cm away from the first group in the same excavation. The torpid animals were left in place and the den was partially reburied and covered with the boulder. When we examined the site on 16 March, six torpid *O. vernalis* were uncovered in the excavation. Four of these snakes were in a tight cluster beneath a rock ca. 45 cm below the ground surface. Soil temperature at this depth was 13.3 deg C. No other reptiles were found during this visit.

The hibernaculum site was on a west-facing, mostly unshaded, 45 degree slope and was located ca. 100 m uphill of the narrow floodplain of the Santa Fe River at an elevation of 2250 m. The habitat was an open woodland of piñon pine (*Pinus edulis*) and juniper (*Juniperus* sp.) with an understory of short grass and a few shrubs. Several buildings were located nearby. The soil was damp, fairly tight, clayey loam that contained many large rocks which formed natural underground interstices. The hibernaculum appeared to have been part of a rodent burrow system; although the entrance to the denning area had been disturbed prior to our visit, we located a tunnel, ca. 4 cm diameter, that extended into the rocky hillside from the area that had been excavated. The *T. e. vagrans* and *E. multivirgatus* that were observed

in February therefore could have retreated deeper into the hillside after the site was disturbed. It is also possible, although unlikely, that these reptiles emerged from the hibernaculum before our visit; maximum daily temperatures at Santa Fe from 20 February to 16 March 1992 were 5.6 - 17.8 deg C (mean = 12.4 deg C).

The six *O. vernalis* that we found were measured (120-363 mm SVL) and five were later released. The smallest snake, a female with an umbilical scar still evident, was retained as a voucher specimen (Museum of Southwestern Biology, University of New Mexico, MSB 53661).

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APPARENT INTERGRADATION IN TEXAS BETWEEN THE SUBSPECIES OF THE TEXAS BLIND SNAKE (*LEPTOTYPHLOPS DULCIS*)

Hobart M. Smith and David Chiszar

Further evidence derived from 135 specimens from Texas and adjacent parts of Colorado and Oklahoma support Klauber's conclusion that *L. d. dulcis* and *L. dulcis dissectus* are conspecific, but the area of intergradation is much broader in Texas and Oklahoma, based on dorsal scale count as well as on division of the anterior supralabial, than he and subsequent workers have thought.

The list of taxa (Collins, 1991) that merit reexamination of their species-group nomenclatural rank (Dowling, 1993) might well have included *Leptotyphlops d. dulcis* (Baird and Girard) and *L. dulcis dissectus* (Cope), which Klauber (1940: map) depicted with broadly overlapping ranges and (ibid: 116) suggested might be allospecific (in which case *dissectus* would be a subspecies of *L. myopicus* (Garman)). Smith (1944: 136) concluded that the broad overlap depicted in Klauber's work is better interpreted as indicative of allospecificity of *L. dulcis* and *L. myopicus*. That conclusion was reiterated in Smith and Taylor (1945: 21, 23) and in Smith and Sanders (1952: 215-217). However, faith in the sound authority of Klauber's conclusion of conspecificity has since then prevailed.

Klauber (1940) assigned his material of this complex to their respective taxa on the basis of presence of one (*L. dulcis*) or two (*L. dulcis dissectus*) anterior supralabials (as here expressed, merely for convenience; Klauber correctly, we think, regarded the anterior supralabial simply as divided or not); specimens with two on one side and one on the other were regarded as intergrades. His map thus depicted a considerable overlap of the ranges of the two subspecies, with intergrades scattered throughout much of the overlap area. Several other general distinctions between the two taxa were noted in detail (number of dorsal scales, division of the occipital, width of the 5th dorsal) in his very thorough survey of variation, but ultimate taxonomic assignment was individually typological (based strictly on the anterior supralabial), not populational.

It was on populational grounds that Smith and Sanders (1952) argued for allospecificity, admittedly by conjecture, since adequate

comparative material was not available to them, although the conclusion of conspecificity was at that time, and earlier, equally conjectural.

Inasmuch as the rank of these two taxa has not been addressed seriously since 1952, we here report pertinent data on 135 specimens, mostly from critical areas of range overlap or intergradation. Seven previously reported by Smith and Sanders (1952) from Baylor and Montague Cos., Texas, are included among those 135 because of their critical import; none of the other 128 have been reported in the present context. Those 128 are in the collections of Midwestern State University of Wichita Falls, Texas (MWSU, 36) Texas Technological University (TTU, 24), West Texas State University (WTSU 63) and the University of Colorado Museum (UCM, 5). The material reported by Smith and Sanders (1952) is in the University of Illinois Museum of Natural History (UIMNH, 7).

Results

Allocations. The results of our study are best discussed in terms of our final taxonomic assignments (Fig. 1; Appendix). Specimens assigned to *L. dulcis dissectus* (19) are from Baca Co., Colorado, and Hemphill, Hutchinson, Lubbock, Potter and Randall Cos., Texas, all in or near the Texas Panhandle. *L. d. dulcis* is represented by specimens (32) from Murray Co., Oklahoma, and Bandera, Coleman, Gonzales, Guadalupe, Hays, Kimble, Mills and Travis Cos., Texas. The remaining 84 are all regarded as intergrades between the preceding two taxa, and are from Jefferson Co., Oklahoma, and Archer, Baylor, Childress, Clay, Crosby, Dickens, Garza, King, Llano, Montague, Motley, Terrell and Young Cos., Texas (localities within counties are given in the Appendix).

Anterior supraoculars. All 19 specimens assigned to *L. dulcis dissectus* have 2-2 anterior supraoculars, except for the one from Lubbock Co., with 1-2. The latter specimen was taken very near intergrade territory in adjacent Crosby and Garza Cos., and perhaps should also be considered an intergrade; its dorsal scale count of 234, however, combined with its 1-2 anterior supralabials and fringe position between the ranges of the two subspecies, leads us to assign it to *L. dulcis dissectus*.

All 32 *L. d. dulcis* have 1-1 anterior supralabials, and only three (of 15 from Mills Co., close to the area of intergradation, with 233, 235, and 238 dorsals) have more than 231 dorsals.

Of the 84 intergrades, all have 1-1 anterior supralabials except for two with 2-2 (MWSU 28, Clay Co.; MWSU 1447, Archer Co.) and one with 1-

2 (UIMNH 24578, Montague Co.). The Clay Co. specimen has a horizontal instead of a vertical division of the anterior supraocular on one side. Klauber (1940: 115) reported four intergrades (i.e., specimens with 1-2 anterior supraoculars) from three localities in central and southwestern Oklahoma, north of which, in northern Oklahoma and southwestern Kansas, all specimens had 2-2 anterior supralabials and were therefore regarded as *L. dulcis dissectus*. One with 2-2 anterior supralabials, from southwestern Oklahoma, Klauber assigned to *L. dulcis dissectus* in spite of being surrounded by localities from which *L. d. dulcis* came and having fewer than 224 dorsals.

On the basis of this character, the two taxa may be judged as constituting two sympatric species, with occasional hybridization (as Klauber was tempted to conclude, and indirectly so argued), or as subspecies having an erratic occurrence of one or two anterior supralabials throughout an area of intergradation. The evidence is inconclusive, except that the former conclusion presupposes that variation in other respects, especially in the dorsal scale count, is meaningless.

Dorsals. We counted these scales by Klauber's method, beginning with the first scale posterior to the rostral, and not including the terminal spine. All counts are shown in Table 2. As Klauber was well aware, the two taxa differ markedly in number of dorsals, the more western subspecies having more (230 or more, with the one exception previously mentioned, with 224), the eastern one fewer ("in the area of intergradation, usually...less than 220"). However, Klauber's concept of the area of intergradation was limited to central and southwestern Oklahoma, the only area where he knew the condition of 1-2 anterior supraoculars occurred. Such specimens are now known from northern Texas, and presumably occur in other areas we interpret as zones of intergradation, depending perhaps upon sample size, which was small in Klauber's study.

However, the total range of variation in dorsal scale count in *L. d. dulcis*, as assigned by Klauber (1940: 109, 113), is 206-255, overlapping completely his range of *L. dulcis dissectus* (224-246, all but one of which we would regard as intergrades, 230 or more). The great range in the former taxon was suggestive to Klauber (1940: 111) of the possibility that *L. d. dulcis* "may really be a composite." On the contrary, much of that variation is due to a strong N-S cline, as Klauber pointed out (1940: 111), with a shift of means from 219 in Comanche Co., southwestern Oklahoma, to 227 in central Texas, and to 237 in southern Texas. Equally strong, in our opinion, is the influence of intergradation between the two subspecies in the areas of Texas noted in Fig. 1.

In those areas, of particular note is the total range of variation (214-245) in the intergrade material from northern central and central Texas,

Garza Co. (233-245) and Terrell Co. (221, 240). On the contrary, the counts in southern central Texas (of *L. d. dulcis*) are consistently low (217-231, with three exceptions, to 238), and those of *L. dulcis dissectus* in Colorado and the Texas Panhandle vicinity are consistently high (230-242). With our small samples of non-intergrade populations these figures would be suspect statistically, but their validity, in general, is fully supported by Klauber's (1940) data.

The over-all picture derived from the dorsal scale counts is highly suggestive of a broad area of intergradation between the two taxa, as shown in Fig. 1; there is no hiatus indicative of allospecificity as suggested might occur by Smith and Sanders (1952). Analysis of variance reveals a significant variation among the means (Fig. 2) for *L. d. dulcis*, *L. dulcis dissectus* and the proposed intergrades ($F = 20.33$, $df = 2132$, $P < 0.01$). Non-orthogonal contrasts (Dunn, 1961) showed that the means for *L. d. dulcis* and the intergrades do not differ but that both of these are significantly lower than the mean for *L. dulcis dissectus*. Neither the divided anterior supralabial nor the high dorsal scale count characteristic of *L. dulcis dissectus* exhibits much penetrance into the genome of *L. d. dulcis*, although the latter character is less completely overwhelmed than the former.

Occipitals. As pointed out by Klauber (1940: 116), the occipitals are frequently split into two scales in *L. dulcis dissectus*, seldom in *L. d. dulcis* (one in 53 from Texas and Oklahoma). Ten of our 19 of the former subspecies have the occipital split on one or both sides (the exceptions are from every county except Hemphill); it is split on one side only in one of our 32 *L. d. dulcis*. In only two of our 84 intergrades is the occipital split, and in both on one side only (King and Llano Cos., Texas). The character is of little value in establishing rank of the two taxa; although the split condition occurs in a strong, statistically significant proportion of *L. dulcis dissectus*, it is not an acceptable taxonomically diagnostic proportion (about half).

Fifth dorsal. Klauber (1940: 116) noted that the first postcranial dorsal scale is wider than the following scales in the western subspecies, seldom in the eastern. In our 19 *L. dulcis dissectus*, only 12 have that scale widened, and in five of the 32 *L. d. dulcis* it is also widened. Among the 84 intergrades, the scale is widened in 13. The character is of minimal diagnostic value.

Other differentiae. Smith and Sanders (1952) suggested two other features that, with larger series, might prove to differentiate the two taxa: pigmented infralabials, and more numerous (9-11) pigmented posterior dorsal scale rows in *L. dulcis dissectus* than in *L. d. dulcis* (with no pigmented infralabials and seven pigmented posterior dorsal scale rows). We found four

specimens (3 *L. d. dulcis*, 1 intergrade) in the present series of 135 with pigmented infralabials, and the number of pigmented posterior dorsal scale rows varied 5-9 without taxonomic correlation. Many of the specimens were, however, either too faded or too discolored for evaluation of either character.

Aberrations. Several anomalous variations were noted, as follows. The supraoculars are in contact medially in TTU 2442b from Terrell Co., and the right one is divided in MWSU 1441 from Clay Co. The frontal is split into two scales, and the interoccipital into three, in MWSU 1440, also from Clay Co. The right parietal is divided in MWSU 6 from Archer Co. The 5th dorsal is divided in UCM 55596 from Baca Co., much reduced in size, to that of the preceding dorsals, in WTSU 10882 from Coleman Co., and is preceded by medial contact of the anterior paravertebral scales in WTSU 13823 from Guadalupe Co.

It may be of interest to note that the smallest individual examined measured 71 mm in total length.

Discussion

Apparently *L. d. dulcis* and *L. dulcis dissectus* are externally distinguishable from each other only on the bases of two characters: number of anterior supralabials, and number of dorsals. Those two characters exhibit intermediacy or breakdown in partly disparate regions. The anterior supralabials are 1-2 only in specimens recorded from northern Texas (Archer, Clay, Lubbock and Montague Cos.) and (as reported by Klauber, 1940) in central and southwestern Oklahoma. There is in addition an anomalous (?) specimen with 1-1 supralabials (not seen by us but assigned by Klauber to *L. d. dulcis* on the basis of its single anterior supralabial; its dorsal scale count was not given, but probably conforms with other *L. dulcis dissectus* if it is correctly thought to be from Cimarron Co., Oklahoma, in the middle of the range of the latter subspecies; that locality may be in error, but the museum was not cited and therefore we could not check the specimen).

The dorsal scale counts, however, range widely where we indicate (Fig. 1) the area of intergradation, spanning our count extremes for both *L. d. dulcis* and *L. dulcis dissectus*, and that area overlaps the area of intermediate supralabial counts and extends through most of central western Texas.

Since the area of broad overlap in dorsal scale count includes the area of anterior supralabial intermediacy, we conclude that not only are the two taxa conspecific (although allosubspecific), but their area of intergradation

should be conceived as coincident with the approximate area of dorsal scale count overlap, as shown in Fig. 1, not the very restricted area from which intermediate anterior supralabial counts are now known.

The erratic distribution of variation in the intergrade area, rather than a smooth transition from one range of variation to the other, suggests that Klauber (1940: 116) correctly surmised that the two subspecies are of secondary origin, having remerged after a period of separation. Subsequent introgression through interbreeding apparently has been too extensive to warrant recognition of the two taxa, as they now stand, as separate species.

Acknowledgments

We are much indebted to Drs. Walter W. Dalquest and Fred Stangl of Midwestern State University, and to Dr. Steven Williams of Texas Technological University, for a long-term loan of the core material for this study; to Drs. Kathleen B. Blair and Flavius Killebrew for their hospitality during the stay of HMS at West Texas State University, studying material in their museum; to Dr. Shi-Kuei Wu of the University of Colorado for permission to study material under his care; and to Drs. William M. Lewis, Chairman, EPO Biology of the University of Colorado, and Michael C. Grant of the same Department, for provision of vital facilities.

Table 1. Dorsal Scale Count Distribution in Present Samples of *Leptotyphlops dulcis**

1	2	3	4	5
213	1	0	0	1
214	1	1	0	0
215	5	2	0	3
216	1	1	0	0
217	3	1	0	2
218	4	3	0	1
219	6	6	0	0
220	4	3	0	1
221	12	8	0	4
222	8	5	0	3
223	10	7	0	3
224	8	7	0	1
225	3	3	0	0
226	6	2	0	4
227	4	3	0	1
228	3	3	0	0
229	3	1	0	2
230	1	0	1	0
231	6	3	0	3
232	4	4	0	0
233	6	1	4	1
234	6	2	4	0
235	7	5	1	1
236	4	3	1	0
237	5	3	2	0
238	5	2	2	1
239	2	1	1	0
240	2	1	1	0
241	1	0	1	0
242	2	1	1	0
243	1	1	0	0
244	0	0	0	0
245	1	1	0	0
Total	135	84	19	32

*Columns: 1, no. of dorsals, total range; 2, distribution in all specimens examined; 3, distribution only of "intergrade" material (see Fig. 1 and Appendix); 4, distribution in *L. dulcis dissectus* only; 5, distribution in *L. d. dulcis* only, outside of the area of assumed intergradation.

Table 2. Raw Dorsal Scale Counts in *Leptotyphlops dulcis*

County	Dorsal Scale Counts
Archer	- 223, 224, 225, 226 (2), 228, 235, 238
Baca	- 234, 235, 236
Bandera	- 220, 224, 226, 231 (2)
Baylor	- 221, 223
Childress	- 225
Clay	- 215, 218, 219 (3), 220, 221 (2), 222 (2), 223 (3), 224 (3), 228, 229, 231, 232 (2), 234, 235, 237, 242
Coleman	- 217, 221
Crosby	- 221
Dickens	- 228, 231
Garza	- 233, 236, 243, 245
Gonzales	- 229
Guadalupe	- 218, 223, 226
Hays	- 217
Hemphill	- 233 (2)
Hutchinson	- 233, 234, 237, 239, 240, 241
Jefferson	- 219, 223, 235
Kimble	- 213
King	- 227, 234
Llano	- 214, 217, 218 (2), 219 (2), 220 (2), 221 (3), 222 (2), 223, 224 (2), 227 (2), 231, 232 (2), 235, 236 (2), 237, 238, 239
Lubbock	- 234
Mills	- 215 (2), 221 (3), 222 (2), 223 (2), 227, 229, 231, 233, 235, 238
Montague	- 215, 216, 222, 224, 235
Motley	- 225
Murray	- 215
Potter	- 230, 234, 238 (2), 242
Randall	- 233, 237
Terrell	- 221, 240
Travis	- 222, 226 (2)
Young	- 237

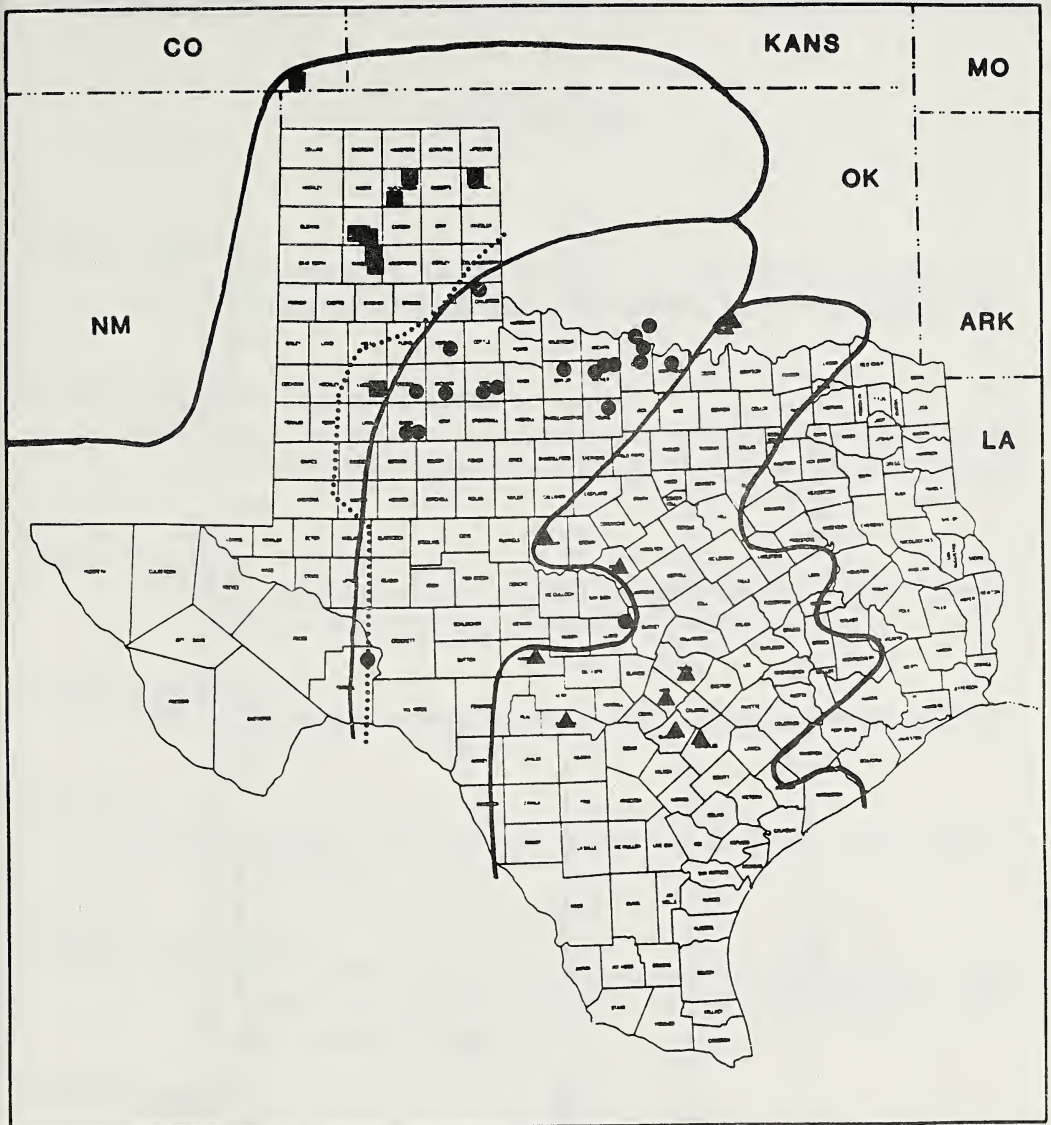


Fig. 1. Distribution of *Leptotyphlops dulcis* in Texas and adjacent areas to the north (base map adapted from Dixon (1987: 135), with symbols indicating localities represented by material examined (squares, *L. d. dissectus*; dots, *L. d. dulcis dissectus* x *L. d. dulcis*; triangles, *L. d. dulcis*). The dot north of Clay Co., Texas, represents Waurika, Jefferson Co., Oklahoma; north of Cooke Co., 15 mi N Ardmore, Murray Co., Oklahoma; and north of Dallam Co., Sand Canyon, Baca Co., Colorado. Dotted line, boundary between the ranges of the two subspecies as depicted by Davis (1987: 234). Areas outlined by continuous lines represent the approximate range limits of the taxa indicated by enclosed symbols (adapted from present data; Conant and Collins, 1991: map 138; Dixon, 1987: 234; and Klauber, 1940: 158).

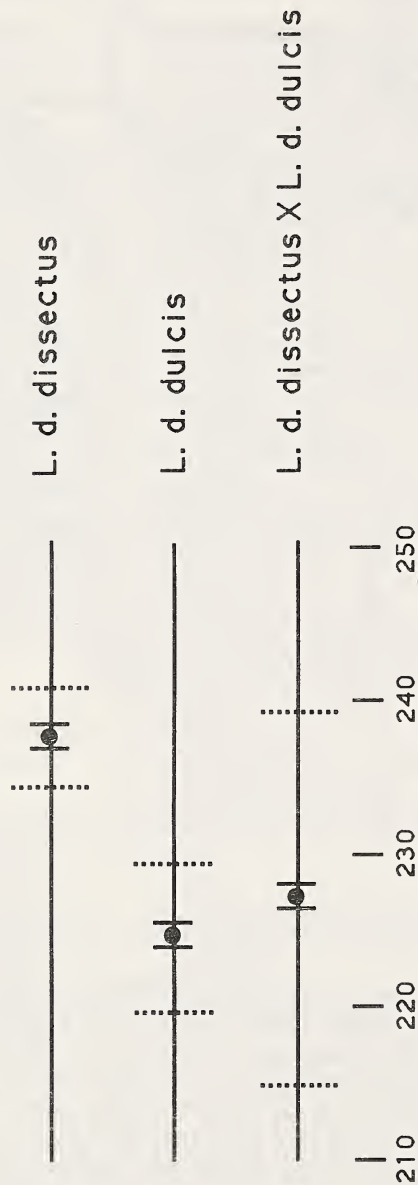


Fig. 2. Mean, standard error of the mean (between solid vertical lines) and standard deviation (between dotted vertical lines) for number of dorsal scales in *L. dulcis dissectus*, *L. d. dulcis* and the proposed intergrades.

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Appendix

The 135 specimens here dealt with are from the following localities, and in the indicated collections.

L. d. dulcis (32)

OKLAHOMA. *Murray Co.*: Hy 77 15 mi N Ardmore (WTSU 10636).

TEXAS. *Bandera Co.*: 10 mi W Medina (TTU 217a-e). *Coleman Co.*: Hords Creek Reservoir (WTSU 10757, 10882). *Gonzales Co.*: Palmetto State Park (WTSU 9912). *Guadalupe Co.*: railroad by McQueeney Dam (WTSU 13823-4); Jct Hy 464 and 1620, 2 km W Seguin (WTSU 14016). *Hays Co.*: 2 mi W Wimberley (UCM 7970). *Kimble Co.*: Robinson Ranch nr Junction (WTSU 9990). *Mills Co.*: Caraway Ranch, 3.4 mi E jct Hy 16 and 3023 (WTSU 3003, 3240, 3280, 3335-8, 3407-11, 3524-6). *Travis Co.*: Austin (WTSU 3276, 8735; UCM 24239).

L. dulcis dissectus (19)

COLORADO. *Baca Co.*: Sand Canyon, 25 mi S Pritchett (UCM 55594-6).

TEXAS. *Hemphill Co.*: 6 mi E Canadian (TTU 1554, 2196). *Hutchinson Co.*: 18 mi N Phillips (NE outskirts of Borger) on Plemons Rd (WTSU 1907-11); 35 mi E Stinnett (TTU 935). *Lubbock Co.*: Buffalo Lakes (TTU 21). *Potter Co.*: Hy 61 34 km NW Hy 66 in Amarillo (WTSU 923); Tascosa Rd, Amarillo (WTSU 1912-5). *Randall Co.*: Palo Duro Canyon (WTSU 3210); Palo Duro State Park (TTU 1818).

L. d. dulcis x *L. dulcis dissectus* (85)

OKLAHOMA. *Jefferson Co.*: Waurika (MWSU 20, 28, 1438, 1440-5, 18358-9).

TEXAS. *Archer Co.* (all MWSU): Lake Kickapoo (1650); 2 mi E Lake Kickapoo (1651); 10 mi N Scotland (1652); 5 mi W (1447), 8 mi S (27), 9 mi S (26, 28), 20 mi SW (6) Wichita Falls. *Baylor Co.*: 15 mi N Seymour (UIMNH 4490-1). *Childress Co.*: 14.5 mi E Memphis (TTU 255). *Clay Co.* (all MWSU): no locality (27); 3 mi SE (1432-7), 4 mi SE (1448-52), 8 mi SE (1431, 1446) Byers; Henrietta (12); 1 mi E Henrietta (1648-9). *Crosby Co.*: 13.5 mi S Crosbyton (TTU 2579). *Dickens Co.*: Spur ranch (TTU 1104a-b). *Garza Co.*: 6 mi E Justiceburg (TTU 521a-b); 10 mi SE Post (TTU 507a-b). *King Co.*: 13 mi W Benjamin (TTU 895); 7.2 mi S Guthrie (TTU 2771). *Llano Co.*: Lake

6712, 6726, 6734, 6774-6, 8398, 8619, 3 uncataloged). *Montague Co.*: 1 mi S St. Jo (UIMNH 14578-82). *Motley Co.*: 2.6 mi SW Matador (TTU 2046). *Terrell Co.*: 22 mi S Sheffield (TTU 2442a-b). *Young Co.*: 5.6 mi NW Loving (TTU 1005).

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A MICROCHIP MARKING SYSTEM FOR IDENTIFICATION OF CAIMAN HATCHLINGS

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Most of research and management projects concerned with animal repopulation and population studies depend on safe, reliable marking techniques for individual identification. An increasing market is offering wildlife workers various choices in this technical demand (Day et al., 1980). Permanent techniques for marking reptiles, such as toe-clipping, scale clipping, cryo-branding and radio-tagging have been used and a literature review on this concern can be found in Ferner (1979), Thomas (1977) and others.

In Eastern Formosa (northeastern Argentina) we have used hot branding, dorsal crest tagging, dorsal crest clipping and web tagging in reptiles, primarily crocodilians. All of these available techniques proved to be not as successful as expected. Hot branding in tegu lizards (*Tupinambis teguixin*) is not applicable for this species because of the elasticity of the skin. Various days following hot-branding, the mark is unreadable, depending upon the growth of the animal and severity of the branding. This method leaves a mark indicating that the animal has been identified/marked but no information for individual identification is provided. Toe-clipping (*Tupinambis teguixin*, *Caiman latirostris* and *Caiman yacare*) is an useful technique but we are unsure about the potential animal damage because of the absence of the finger or toe. In addition, some recaptured animals have shown natural amputation of other digits, rendering this method as largely unreliable. Web-tagging and dorsal crest clipping have been widely used in both species of caimans but the first method is unreliable because many tags are lost and in highly populated areas many animals show limb and tail losses due to aggressive encounters (Yanosky, 1990). Dorsal-crest clipping is difficult to practice in hatchlings. As hatchlings increase in size, the permanent mark may or may not be identifiable. Dorsal-crest tagging as a permanent technique is inappropriate in caiman hatchlings because of the small size of the crests. Tags applied to the third dorsal crest in adults have been lost numerous times, the number is difficult to identify and those animals who lose their tails, automatically lose the tag. Both toe- and dorsal crest-clipping limit the number of animals that can be marked.

In this paper, we acknowledge the effectiveness of a microchip marking technique for *Caiman latirostris*. This is a relatively new technique

for individual identification, known as Passive Integrated Transponders (PITs) or Radio Frequency Tags (RFTs). These PITs have been used in fisheries biology to identify salmonids (Prentice et al., 1985). This system is based on a inert 2 mm X 12 mm microchip, encased in transparent glass material, which is activated by a low frequency radio signal (e.g. reader) that transmits the code to the reading system. Each chip is pre-programmed with a unique code that cannot be altered. The microchip weighs about 0.6-0.7 g and is passive (lasts indefinitely). The chip requires no battery to function. The numerical system is normally alpha-numerical such as 7A8F15068 with some 7×10^9 potential combinations. The 9 number/letter combinations are useful, but usually the three last numbers/letters suffice. Normal cost for each microchip (PIT) is about \$4.60 and the system requires a reader which is activated by a switch. After a fast pass with the reader, no more than 10 cm from the pit, a liquid crystal module displays the identification number. The reader is powered by two 3.6 V lithium batteries and is valued at \$600.

The PIT can be placed subcutaneously with the aid of a syringe and #12 gauge needle. The pit, needle, and syringe are sterilized with ethanol. Transponders are easily inserted using a specially designed syringe. The location of the microchip is very important and should correspond to a standard location for a quick reading. Both transponders and reader operate on a 125 kHz frequency. Camper and Dixon (1988) have made comments on a similar system (400 kHz) applied to many other herpetotaxa.

We have implanted 19 eight-months-old *Caiman latirostris* hatchlings with a general average of 150.52 ± 20.94 g (CV = 13.91) in body mass and 168.15 ± 9.88 mm (CV = 5.88) and 332.73 ± 19.92 mm (CV = 9.1) in snout-vent and total length, respectively. We also implanted three 20-months-old caiman juveniles with 223.33 ± 70.23 g, 215 ± 5 mm and 440.6 ± 15.1 mm for the same parameters. The most appropriate and standardized (by us) location for the subcutaneous microchip implant was at the left side of the tail base, just after the insertion of the left hindlimb with the body, longitudinal to the tail. The wounds were not cleaned after the injections, only the microchips were dipped in ethanol prior to implantation. Periodic "Readings" were carried out with the implanted caimans. According to Camper and Dixon (1988), a reading is defined as a successful activation of the implanted PIT with the reader.

No implanted caiman hatchlings died after 4 months of implantation. No PIT tag failed to operate correctly giving thus a 100% efficiency rating. Of eight reading periods, with a total of 170 readings, 160 were successful on the first "reading" attempt (first pass of the reader in front of the place where the PITs were implanted). The 10 remaining readings were all successful

during the second pass. The injection of the microchips left no scar on the skin. This may be due to the care and insertion of the tag in the line where two plates join. It is evident that the chips did not migrate under the skin, otherwise the "reading" would not have been successful.

This method appears to be superior to most systems for marking caimans used so far. An unlimited number of animals can be permanently marked with no ill effects. We have no evidence that the use of PIT's harm or endanger the lives of crocodiles and alligators. Thailand's crocodile breeders do not accept this method for marking hatchlings due to potential death and tail loss (Hull, in litt). The portable nature of the reader instrument is a great advantage for field work and field laboratory testing. Besides, the chips do not alter the external appearance of tagged individuals.

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THE HERPETOFAUNA OF EL BAGUAL ECOLOGICAL RESERVE (FORMOSA, ARGENTINA) WITH COMMENTS ON ITS HERPETOLOGICAL COLLECTION

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El Bagual Ecological Reserve was created in 1985 to protect subtropical Argentine moist habitats north to the Bermejo River Lowlands. This area is strategically located among Rio Pilcomayo National Park on the north, Formosa Nature Reserve on the east and Chaco National Park on the south. The reserve has 3600 hectares with a biological station that includes a modest laboratory. Since 1987, surveys were designed to generate a database on biodiversity of the fauna and flora for the Formosan Humid Chaco Region, a poorly known area within Argentina. A good grasp of biodiversity in the area is important as cultural stock of the humanity, sharing in part Bucher's objective (1980) on having at disposal management guidelines before the advance of human activities puts the natural resources in danger. In general the area is poorly known and, on the other hand, is one of the richest zones of Argentina.

The El Bagual Herpetological collection (REB-A) was created as a private collection. However, because of its "private" nature, scientists within Argentina were reluctant to cite the important scientific material contained therein, because the perpetuation of privately-owned collections is not guaranteed. However, there are today privately-owned collections, sometimes helped with external funds, that are utilized by the scientific community such as the Strecker Museum, Baylor University (Texas), R. W. Axtell (Illinois), E. A. Liner (Louisiana), Peabody, Yale University (Connecticut), Witte Museum (Texas), and Smith College (Massachusetts). Many private colleges house private collections, and these are made available to the scientific community. It is interesting that some major public museums were once private, e.g., Field Museum of Natural History, Chicago, and the Carnegie Museum, Pittsburgh.

The establishment of the REB-A collection was to document the flora and fauna of the preserve. The collection is one of the objectives of the preserve (Yanosky, 1989a) and is not contrary to the objective of maintenance of biodiversity. Its public use helps to inform scientists of the herpetological resources existing in Argentina in particular, and in South America in general.

The objectives of this paper are to 1): update the knowledge of the herpetofauna of El Bagual Ecological Reserve based on material from REB-A and personal experience of the authors, and 2): list the material in the collection to encourage the use of the collection, promoting communication and exchange.

Previous Investigations

At present, Alvarez et al. (1991) and Giraudo et al. (1992) are combining efforts for intensively surveying the herpetofauna of northeastern Argentina. The methodology used by these authors is based on Parring and Walters (Alvarez, pers. com.) cross-sectioned method on an orthogonal matrix with sides of 0.5 geographical degree. One grid of those pertaining to the province of Formosa is occupied in part by Laishí department where El Bagual Reserve is located. The present contribution could be incorporated in future works, resulting in additional knowledge of the herpetofauna of the province and from northeastern Argentina.

The anuran fauna is partially known from isolated reports that have been incorporated into the works of Cei (1980, 1987) and Gallardo (1987). The lizard fauna has been poorly studied in northeastern Argentina and we have only partial data, together with the preliminary report of Alvarez et al. (1988). A recent manuscript on the lizard fauna of El Bagual ecological reserve is under review (Yanosky & Mercolli, 1992a). On the contrary, the snake fauna of northeastern Argentina is better known from the works of Bergna & Alvarez (1990) and Bergna et al. (1992). In addition, there is a recent list of the Argentine Snakes by Williams & Francini (1991), and for the El Bagual Ecological Reserve, Dixon et al., (1993); Yanosky (1989b, c) and Yanosky et al., (in review a).

The Herpetofauna of El Bagual Reserve

The herpetological collection of the reserve is composed of 698 specimens representing 66 species. All of the specimens are from inside or within a few kilometers of the El Bagual Reserve, in identical habitat. Anurans are represented by 301 specimens of 26 species, snakes 215 specimens of 29 species and lizards, including amphisbaenids, 182 specimens of 13 species. Some reptile species are not represented in the collection, but personal observations of these species on the reserve increase the known snake fauna to 32 species, the lizards to 14, along with one species of aquatic turtle and two species of caimans.

Checklist of anurans

<i>Bufo fernandezae</i>	<i>Leptodactylus mystaceus</i>
<i>Bufo granulosus major</i>	<i>Leptodactylus mystacinus</i>
<i>Bufo paracnemis</i>	<i>Leptodactylus ocellatus</i>
<i>Bufo pygmaeus</i>	<i>Leptodactylus cf. podicipinus</i>
<i>Ceratophrys cranwelli</i>	<i>Melanophryniscus stelzneri</i>
<i>Dermatonotus muelleri</i>	<i>Odontophrynus americanus</i>
<i>Elachistocleis bicolor</i>	<i>Phrynohyas venulosa</i>
<i>Hyla nana</i>	<i>Phyllomedusa hypochondrialis</i>
<i>Hyla raniceps</i>	<i>Physalaemus albonotatus</i>
<i>Leptodactylus bufonius</i>	<i>Physalaemus nattereri</i>
<i>Leptodactylus chaquensis</i>	<i>Scinax acuminata</i>
<i>Leptodactylus fuscus</i>	<i>Scinax squalirostris</i>
<i>Leptodactylus marmoratus</i>	<i>Scinax x-signata</i>

The above list of 26 amphibian species are the anurans known to occur within El Bagual Ecological Reserve and differs from the list presented by Yanosky (1989b). The latter list was composed of only 11 species and incorporated *Phyllomedusa sauvagei*, a species which has not been confirmed and herein removed.

The current list was aided by the works of Cei (1980, 1987), Gallardo (1987), and helped us identify and confirm the presence of the following species in the province of Formosa: *Bufo paracnemis*, *B. granulosus major*, *B. fernandezae*, *B. pygmaeus*, *Leptodactylus bufonius*, *L. mystaceus*, *L. ocellatus*, *L. chaquensis*, *L. fuscus*, *L. marmoratus*, *Hyla raniceps* and *H. nana*. The confirmation of these species (especially *Leptodactylus fuscus*, *L. marmoratus* and *L. mystaceus*) is based on the absence of records for the province in public collections or species whose presence in the Argentine territory required confirmation (Cei, 1980).

The sympatry of *Leptodactylus* species in El Bagual Ecological Reserve, especially *chaquensis* and *ocellatus*, and the sympatry of four *Bufo* species provides an excellent opportunity to study anuran behavior, microgeographic segregation, and temporal isolation.

Checklist of snakes

<i>Bothrops alternatus</i>	<i>Liophis jaegeri coralliiventris</i>
<i>Bothrops neuwiedi diporus</i>	<i>Liophis miliaris</i>
<i>Chironius</i> sp.(*)	<i>Liophis poecilogyrus</i>
<i>Clelia bicolor</i>	<i>Mastigodryas bifossatus</i>
<i>Clelia clelia</i>	<i>Micrurus pyrrhocryptus</i>
<i>Clelia rustica</i>	<i>Oxyrhopus guibei</i>
<i>Crotalus durissus terrificus</i> (*)	<i>Philodryas aestivus</i>
<i>Echinanthera</i> sp.	<i>Philodryas patagonensis</i>
<i>Echinanthera occipitalis</i>	<i>Phymophis guerini</i>
<i>Eumectes notaeus</i>	<i>Sibynomorphus turgidus</i>
<i>Helicops leopardinus</i>	<i>Spilotes pullatus</i> (*)
<i>Leptodeira annulata</i>	<i>Thamnodynastes</i> sp.
<i>Leptophis ahaetulla</i>	<i>Thamnodynastes strigilis</i>
<i>Liophis almadensis</i>	<i>Typhlops brongersmianus</i>
<i>Liophis dilepis</i>	<i>Waglerophis merremi</i>

The present list adds 13 additional species to the reserve, altering the 19 snake species list given by Yanosky (1989b, c). Some species on the earlier list were misidentified or whose names have changed due to taxonomic revision, are here corrected: *Micrurus pyrrhocryptus* (= *M. frontalis*

pyrrhocryptus), *Liophis almadensis* (confused with *L. anomalus*), *Liophis dilepis* (confused with *L. flavifrenatus*) and *Oxyrhopus guibei* (confused with *Elapomorphus bilineatus*). *Philodryas baroni* is removed from the list for lack of confirmation.

Species marked with an asterisk (*) are not represented in the herpetological collection. However, their presence in the reserve is confirmed. *Eunectes notaeus* is a common component within the reserve and was prioritized with protection alternatives during an analysis of the snake fauna (Yanosky, 1989c), so that no specimen, except for a hatchling, was captured specifically to be incorporated in the collection. Road-killed individuals will probably be obtained for this purpose.

Crotalus durissus has never been captured or seen within the 3600 ha reserve. Historically however, settlers have spoken about the existence of this rattlesnake in the reserve. This viper is known as "mboi-chini" in Guarani. We have been able to observe specimens no more than 20 km north of the reserve on the right bank of Salado Creek. With respect to the species of *Clelia*, Scrocchi & Viñas (1990) indicated that the apparent absence of *Clelia bicolor* and *C. rustica* in northern Argentina was the lack of adequate sampling. We confirm a considerable range extension for *Clelia rustica* and its sympatry not only with *Clelia bicolor*, but also with *Clelia clelia*. Attempts to capture *Spilotes pullatus* and *Chironius* sp. for incorporation into the herpetological collection were unsuccessful. However, a *Chironius* skin was found among bromeliads in a high humid forest, possibly assignable to *C. bicarinatus* (Bergna, pers. com.). *Rhadinaea occipitalis* (*Echinanthera occipitalis*, according to Di Bernardo, 1992) is here confirmed for the province of Formosa, as suggested by Williams and Francini (1991), and *Liophis dilepis* was recently cited for Argentina by Bergna and Alvarez (1990); Bergna et al. (1992), and a definition of character variation within a local sample of the species is presented by Yanosky et al. (1993). *Typhlops brongersmianus* and *Liophis almadensis* are new records for the province of Formosa (Dixon et al., 1993), together with *Philodryas aestivus* and *Oxyrhopus guibei*. *Liophis jaegeri*, although not cited for the province of Formosa by Dixon (1987), is fairly common on the reserve. *Oxyrhopus guibei*, recently a subspecies of *O. trigeminus*, was elevated to specific level by Zaher and Caramaschi (1989). Zaher (in litt.) cited records from Corrientes City (Province of Corrientes) and La Verde (Province of Chaco). The presence of *Oxyrhopus trigeminus* in Formosa was expected but it was not listed for Argentina by Williams and Francini (1991). *Phimophis guerini* is cited for the first time for the province of Formosa. Previously, this species was known to occur in Corrientes, Chaco, Entre Ríos and Tucumán (Williams and Francini, 1991). In western Formosa (Dry Chaco), *Phimophis vittatus* was found by Bergna et al. (1992). Although Abdala (1990) morphometrically segregated

both species, we suspect that these two species may be conspecific, if not identical. The *Thamnodynastes* species problem will not be resolved until Bailey and Thomas (in litt.) publish their major revision of this genus. The unknown species herein cited does not fit the new combination for the genus in Argentina (Cei et al., 1992).

Checklist of lizards

<i>Ameiva ameiva</i>	<i>Pantodactylus schreibersi</i>
<i>Amphisbaena dubia</i>	<i>Polychrus acutirostris</i>
<i>Kentropyx viridstriga</i>	<i>Teius oculatus</i>
<i>Leposternon microcephalum</i>	<i>Teius teyou</i>
<i>Mabuya dorsivittata</i>	<i>Tropidurus catalanensis</i>
<i>Mabuya frenata</i>	<i>Tropidurus spinulosus</i>
<i>Ophiodes intermedius</i>	<i>Tupinambis teguixin</i>

Except for *Tupinambis teguixin*, all the species cited above are represented in the collection. *Tupinambis teguixin* is a very common species within El Bagual Reserve. It is currently under investigation as an experimental farm animal. Two of us are obtaining basic management guidelines under captive conditions (Yanosky and Mercolli, 1992b, c). Data are also being obtained on population parameters (Yanosky and Mercolli, in press).

The recent report on the lizard fauna of El Bagual Reserve (Yanosky and Mercolli, 1992a) and for the province (Alvarez et al., 1988) confirmed *Mabuya frenata*, *Teius teyou* and *Teius oculatus* for the area. The remaining eleven species are herein confirmed. *Amphisbaena dubia* has been recently cited by us for Argentina (Yanosky et al., 1993b).

Other reptiles

Caiman latirostris

Phrynos hilarii

Caiman yacare

These last three species are also absent in the collection because of the lack of storage space for adults. They are common in the protected area except for *Caiman yacare*. Though present, *C. yacare* is a species of extensive water bodies such as large lagoons, creeks, and rivers (Yanosky, 1990). *Caiman latirostris* is commonly found in smaller water bodies, accompanied by *Phrynos*. A breeding farm was initiated for both species of caimans. The goal is to repopulate depleted areas, and some captive-raised juveniles have been released in El Bagual (Yanosky and Mercolli, 1993). Caimans are not currently deposited in the collection. However, dead hatchlings and juveniles from the farming operation have been donated to the Texas Cooperative Wildlife Collection (U.S.A.). Iverson and College (1992) have not cite *Phrynos hilarii* for the province of Formosa, but the species was cited north of El Bagual in Paraguay and south of it in Paraná River (province of Chaco).

El Bagual Material Examined

Amphibians

Leptodactylus bufonius [n = 2] REB-A 20633, 21146. *Leptodactylus mystaceus* [n=1] REB-A 20678. *Leptodactylus ocellatus* [n = 5] REB-A 20654, 21144, 21167, 21270, 21272. *Leptodactylus mystacinus* [n = 5] REB-A 20643-45, 20836, 20886. *Leptodactylus chaquensis* [n = 56] REB-A 20610-29, 20659-65, 20668-77, 20707, 20820-31, 21166, 21225, 21234-36, 21271. *Leptodactylus marmoratus* [n = 1] REB-A 20640. *Leptodactylus* cf. *podicipinus* [n = 1] REB-A 20641. *Lepidodactylus fuscus* [n = 2] REB-A 20837, 21060. *Ceratophrys cranwelli* [n = 2] REB-A 20840, 21061. *Odontophrynus americanus* [n = 23] REB-A 20839, 20873, 20877, 21226, 21314-32. *Physalaemus albonotatus* [n = 40] REB-A 20601-03, 20635-39, 21101-13, 21140-41, 21194-209, 21274. *Physalaemus nattereri* [n = 1] REB-A 20600. *Bufo paracnemis* [n = 13] REB-A 20680, 20884-85, 21114-23. *Bufo granulosus major* [n = 5] REB-A 20883, 21062, 21142, 21147-48. *Bufo pygmaeus* [n = 18] REB-A 20630-32, 20634, 20642, 20646-53, 21063,

21067, 21143, 21149-50. *Bufo fernandezae* [n = 4] REB-A 20655-58. *Melanophryniscus stelnneri* [n = 5] REB-A 20880-82, 21263, 21313. *Phyllomedusa hypochondrialis* [n = 12] REB-A 20832-35, 20874-76, 21055-59. *Phrynohyas venulosa* [n = 7] REB-A 20871-72, 21181-82, 21281-82, 21293. *Hyla raniceps* [n = 15] REB-A 20679, 20691-92, 20694-95, 20851-59, 21165. *Hyla nana* [n = 10] REB-A 20693, 20860-62, 21072, 21081, 21136-39. *Scinax squalirostris* [n = 13] REB-A 21068-71, 21127-35. *Scinax acuminata* [n = 22] REB-A 20666-67, 20684-90, 20696-97, 20863-70, 21237, 21289-90. *Scinax x-signata* [n = 35] REB-A 20681-83, 20698-706, 20847-50, 21082-100. *Elachistocletis bicolor* [n = 2] REB-A 20878-79. *Dermatonotus muelleri* [n = 1] REB-A 21228.

Snakes

Typhlops brongersmianus [n = 2] REB-A 20792-93. *Eunectes notaeus* [n = 1] REB-A 21292. *Bothrops alternatus* [n = 9] REB-A 20711-15, 21230, 21249-50, 21273. *Bothrops neuwiedi* [n = 37] REB-A 20713-33, 20816, 21050-1, 21154, 21186, 21189, 21218, 21264-66, 21283-85, 21294, 21306, 21311. *Micrurus pyrrhocryptus* [n = 7] REB-A 20734-37, 20817, 21185, 21217. *Helicops leopardinus* [n = 5] REB-A 20744, 21244, 21246, 21280, 21297. *Leptophis ahaetulla* [n = 4] REB-A 20750-51, 21220, 21229. *Liophis almadensis* [n = 10] REB-A 20753-58, 21049, 21125, 21155, 21269. *Liophis poecilogyrus* [n = 28] REB-A 20605, 20766-78, 21053, 21126, 21151, 21153, 21157, 21212, 21221-22, 21224, 21233, 21256-57, 21260, 21298. *Liophis dilepis* [n = 12] REB-A 20759-60, 20842, 21156, 21192, 21223, 21241, 21255, 21267-68, 21295-96. *Liophis miliaris* [n = 4] REB-A 20764-65, 21145, 21213. *Liophis jaegeri* [n = 8] REB-A 20761-63, 21152, 21184, 21190, 21215, 21262. *Echinanthera* sp. [n = 1] REB-A 20752. *Echinanthera occipitalis* [n = 1] REB-A 20609. *Waglerophis merremi* [n = 22] REB-A 20800-12, 20819, 21048, 21214, 21231, 21243, 21245, 21248, 21286, 21304. *Hydrodynastes gigas* [n = 1] REB-A 20745. *Phimophis guerini* [n = 1] REB-A 20608. *Clelia bicolor* [n = 10] REB-A 20604, 20738-43, 21054, 21251, 21259. *Clelia clelia* [n = 3] REB-A 21219, 21291, 21305. *Clelia rustica* [n = 1] REB-A 21216. *Oxyrhopus guibei* [n = 1] REB-A 20783. *Thamnodynastes strigilis* [n = 13] REB-A 20794-99, 20841, 20843-44, 21187, 21238. *Philodryas aestivus* [n = 3] REB-A 20784, 21168, 21254. *Philodryas mato Grossoensis* [n = 1] REB-A 21309. *Philodryas patagonensis* [n = 5] REB-A 20785, 20818, 21047, 21191, 21303. *Mastigodryas bifossatus* [n = 7] REB-A 20779-82, 21288, 21307, 21310. *Sibynomorphus turgidus* [n = 7] REB-A 20786-91, 21276. *Leptodeira annulata* [n = 8] REB-A 20746-49, 21052, 21252-53, 21261.

Lizards

Amphisbaena dubia [n = 1] REB-A 20889. *Leposternon microcephallum* [n = 7] REB-A 20887-88, 20890, 21227, 21240, 21242, 21308. *Tropidurus catalanensis* [n = 1] REB-A 21193. *Tropidurus spinulosus* [n = 2] REB-A 20907-80. *Polychrus acutirostris* [n = 1] REB-A 20909. *Mabuya frenata* [n = 70] REB-A 20846, 20920-70, 21032-43, 21211, 21278, 21299-303. *Mabuya dorsivittata* [n = 12] REB-A 20910-19, 21180, 21188. *Ophiodes intermedius* [n = 21] REB-A 20708-10, 20845, 20891-904, 21044-45, 21312. *Tetius oculatus* [n = 15] REB-A 20999-21012, 21124. *Tetius teyou* [n = 20] REB-A 21013-31, 21210. *Kentropyx viridistriga* [n = 1] REB-A 20905. *Ameiva ameiva* [n = 27] REB-A 20971-76, 20978-98. *Pantodactylus schreibersi* [n = 4] REB-A 20906, 21046, 21275, 21279.

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NOTES

The Natural History Society of Maryland

The Natural History Society of Maryland, Inc. is a non-profit organization dedicated to promoting the appreciation of natural history through research, publication and education.

Established in 1929, the Society has been one of the premier natural history organizations in Maryland. The Society has established a diversified natural history museum and library focusing on Maryland. Activities include: field trips, publication of research findings by local naturalists, and a wide variety of educational activities including informal workshops and lectures.

Research

Our building includes offices and a small meeting room, but most of the available space contains various natural history collections. Museum holdings represent the fields of: archeology, entomology, herpetology, botany, malacology, mineralogy, paleontology, mammalogy, and ornithology.

Collections are available for research and educational activities. We welcome new members who wish to learn more about our collections. Museum volunteers help curate and identify specimens. Members can instruct volunteers in techniques of specimen collection and preparation.

Publication

The Society began publishing shortly after it was established. The precursor to our current journal, *The Maryland Naturalist* first appeared in 1930. The Society also publishes the *Bulletin of the Maryland Herpetological Society*. Other publication include occasional Proceedings and a series of Nature Leaflets. Our newsletter, *News and Views*, contains announcements of lectures and other scheduled activities and short notes about Maryland natural history.

Education

Throughout its history, the Society has worked closely with nature centers and schools to increase opportunities for natural history education. These efforts have included loans of specimens and exhibits, education materials, nature leaflets published specifically for school use and a monthly lecture series offered from September through May.

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The headquarters and museum is open to the public on Wednesdays between 9:30am and 4:30pm. We invite you to visit our museum and meet other members who can help you learn more about Maryland's natural history.

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The Division of Herpetology sponsors The Maryland Herpetological Society which meets each Wednesday from 7:30pm to 9:00pm.

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